PENINSULA MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN

DISASTER MITIGATION ACT OF 2000

January 2006

Executive Summary

The rich historical assets and vast natural resources of the Lower Virginia Peninsula have a long history of vulnerability to a multitude of natural hazards. From colonial-era hurricanes that moved immense quantities of sand to create the spits, points, and creeks of today, to recent tornados that displaced elderly inhabitants, the Peninsula's residents live with the history of past events and constantly strive to prevent damage from future events.

In order to reduce or eliminate the long-term risk to human life and property from natural hazards, the communities of the Lower Virginia Peninsula joined forces to prepare this Multi-Jurisdictional Natural Hazard Mitigation Plan. Comprised of local government representatives from Hampton, Newport News, Williamsburg, James City County and York County, the Peninsula Hazard Mitigation Planning Committee (PHMPC) met regularly over the course of 12 months during 2004 and 2005, to generate the elements of this plan. The elected boards of each jurisdiction reviewed and officially adopted the plan, making it a governing document for their community. AMEC Earth and Environmental was contracted to assist the committee throughout the planning process. AMEC's role included facilitating all meetings of the PHMPC, preparing presentations for all Public Meetings, and instructing committee members about the role of mitigation in hazard preparedness. AMEC coordinated the reviews and comments of committee members, other state agencies including VDEM, and FEMA.

This plan has been prepared in accordance with the requirements of the Disaster Mitigation Act of 2000. This legislation reinforced the importance of pre-disaster infrastructure mitigation planning to reduce disaster losses nationwide, and was aimed primarily at streamlining federal disaster relief and programs to promote mitigation activities. By adopting this plan, the communities of the Peninsula will be better prepared to integrate mitigation actions into other community programs by:

- building public support for mitigation activities,
- developing effective public education policies regarding mitigation, and
- obtaining disaster-related grants in the aftermath of a disaster.

The elements of this plan coincide with the primary planning tasks performed by the PHMPC. First, the committee conducted a risk assessment by analyzing and prioritizing the critical natural hazards that threaten the region: floods, hurricanes, nor'easters, winter storms, tornados, and wildfires. The vulnerability of each community to each critical hazard was examined in terms of assets at risk by dollar value, and critical facilities (police/fire stations, hospitals, schools, etc.) at risk. A capability assessment examined existing programs and mechanisms in place to mitigate the effects of natural hazards.

Armed with a detailed risk assessment, the PHMPC set regional mitigation goals to address areas where improved capabilities could reduce vulnerability. Goals, and objectives for achieving the goals, were further refined into mitigation alternatives, or "recommended action items". These detailed tasks for each community form the crux of the plan, and can be broken down into the following categories:

- prevention,
- property protection,
- structural projects,
- natural resource protection,
- emergency services, and
- public information.

With the adoption of this plan, each community's sub-committee is converted to a permanent advisory body referred to as the Mitigation Coordinating Committee (MCC) whose primary duty is to see the plan successfully carried out. Plan maintenance must be an ongoing effort to monitor and evaluate the implementation of the plan, and to update the plan as progress, roadblocks, or changing circumstances are recognized. Monitoring and updating will take place through an annual review by the MCC and a five-year written update to be submitted to the Virginia Department of Emergency Management and FEMA Region III, unless disaster or other circumstances lead to a different timeframe.

TABLE OF CONTENTS

PAG E

1.0 Introduction 5
1.1 Scope 5
1.2 Plan Organization 6
2.0 Regional Profile 7
2.1 History of the Peninsula Region 9
3.0 Planning Process 13
4.0 Hazard Identification and Risk Assessment 19
4.1 Hazard Identification 19
4.1.1 Multi-Hazard Correlation 21
4.1.2 Flooding 22
4.1.3 Hurricanes and Tropical Storms 23
4.1.4 Tornados 27
4.1.5 Nor'easters 29
4.1.6 Thunderstorms 32
4.1.7 Winter Storms 34
4.1.8 Extreme Heat 36
4.1.9 Dam Failure 37
4.1.10 Wildfire 38
4.1.11 Drought 39
4.1.12 Earthquakes 41
4.1.13 Biological Hazards/Epidemics 49
4.1.14 Landslide 50
4.1.15 Expansive Soils 50
4.1.16 Tsunami 50
4.1.17 Sea Level Rise 51
4.1.18 Critical vs. Non-critical Hazards 52
5.0 Community Specific Profiles 55
5.1 City of Hampton Profile 58
5.1.1 Flooding – City of Hampton 58
5.1.2 Hurricanes – City of Hampton 59
5.1.3 Tornados – City of Hampton 60
5.1.4 Wildfire – City of Hampton 61
5.1.5 Vulnerability Assessment – City of Hampton 62
5.1.6 Capability Assessment – City of Hampton 67
5.2 City of Newport News Profile 73
5.2.1 Flooding – City of Newport News 73
5.2.2 Hurricanes – City of Newport News 74
5.2.3 Tornados – City of Newport News 75
5.2.4 Wildfire – City of Newport News 76
5.2.5 Vulnerability Assessment – City of Newport News 76
5.2.6 Capability Assessment – City of Newport News 83
5.3 City of Williamsburg Profile 90
5.3.1 Flooding – City of Williamsburg 90
5.3.2 Hurricanes – City of Williamsburg 91
5.3.3 Tornados – City of Williamsburg 92
5.3.4 Wildfire – City of Williamsburg 93
5.3.5 Vulnerability Assessment – City of Williamsburg 93
5.3.6 Capability Assessment – City of Williamsburg 96
5.4 James City County Profile 101

5.4.1 Flooding – James City County 101
5.4.2 Hurricanes – James City County 102
5.4.3 Tornados – James City County 103
5.4.4 Wildfire – James City County 104
5.4.5 Vulnerability Assessment – James City County 104
5.4.6 Capability Assessment – James City County 107
5.5 York County Profile 114
5.5.1 Flooding – York County 114
5.5.2 Hurricanes – York County 116
5.5.3 Tornados – York County 118
5.5.4 Erosion – York County 118
5.5.5 Wildfire - York County 119
5.5.6 Vulnerability Assessment – York County 120
5.5.7 Capability Assessment – York County 127
5.6 State, Regional, and Federal Capabilities 136
6.0 Mitigation Goals and Objectives 143
6.1 Review of Mitigation Alternatives 145
6.1.1 Using Criteria to Analyze and Select Mitigation Measures 146
6.1.2 Reaching Consensus by Prioritizing Mitigation Measures 147
6.1.3 Action Plan 149
6.2 The Mitigation Strategy 150
6.3 Peninsula Mitigation Recommendations 151
6.3.1 Hampton Mitigation Recommendations 151
6.3.2 Newport News Mitigation Recommendations 160
6.3.3 Williamsburg Mitigation Recommendations 169
6.3.4 James City County Mitigation Recommendations 176
6.3.5 York County Mitigation Recommendations 183
7.0 Plan Implementation and Maintenance 194
7.1 Maintenance 195

LIST OF TABLES

PAGE

Table 1.2 Plan Organization 6
Table 2a Regional Population Statistics 8
Table 2b 2004 Annual Building Permit Data 8
Table 3a DMA 2000/CRS Planning Requirements 13
Table 3b PHMPC Meeting Focus 15
Table 3c Public Input Meeting Dates 16
Table 4.1 Presidential Disaster Declarations in Virginia, 1953 –2005 20
Table 4.1.3 Saffir-Sampson Scale 25
Table 4.1.4a Fujita Damage scale 28
Table 4.1.4b Significant Historical Tornados Impacting the Peninsula 29
Table 4.1.5a Dolan-Davis Nor'easter Intensity Scale 30
Table 4.1.5b Historic Virginia Nor'easters 31
Table 4.1.6 Recent Lightning Damage for Peninsula Communities* 33
Table 4.1.7 Significant Winter Storm Events 35
Table 4.1.8 Heat Index 36
Table 4.1.9 Number of Dams by Community and Hazard Classification 38
Table 4.1.10 Wildfire Hazard for Peninsula Communities 39
Table 4.1.11 U.S. Drought Monitor, Drought Severity Classification 40
Table 4.1.12a Modified Mercalli Intensity Scale 44
Table 4.1.12b Summary of Virginia Earthquake Data 48

Table 4.1.17	Hazard Identification Results	53
Table 5-	Capability Matrix (Example)	56
Table 5.1.1a	Significant Flood Events	58
Table 5.1.1b	NCDC Significant Flood Events –City of Hampton	59
Table 5.1.3	Historic Tornados – City of Hampton	61
Table 5.1.5a	Summary of Flood Analysis – City of Hampton	62
Table 5.1.5b	Value of Structures Exposed to High Wind – City of Hampton	64
Table 5.1.5c	Summary of Probabilistic Analysis – Residential Structures – City of Hampton	64
Table 5.1.5d	Critical Facilities at Risk – 100-Year Floodplain	66
Table 5.1.5e	Critical Facilities at Risk –Surge Zone Hurricane Category 4	66
Table 5.1.5f	Critical Facilities at Risk - High Wildfire Hazard Zone	66
Table 5.1.6	Capability Matrix – City of Hampton	67
Table 5.2.1a	Significant Flood Events	73
Table 5.2.1b	NCDC Listed Significant Flood Events –City of Newport News	74
Table 5.2.2	Historic Hurricanes – City of Newport News	74
Table 5.2.3	Historic Tornados – City of Newport News	76
Table 5.2.5a	Value of Exposed Structures from HAZUS®MH – City of Newport News	78
Table 5.2.5b	Summary of Probabilistic Analysis – Residential Structures – City of Newport News	78
Table 5.2.5c	Critical Facilities in 100-Year Floodplain	80
Table 5.2.5d	Critical Facilities at Risk - Surge Zone Hurricane Category 4	80
Table 5.2.5e	Critical Facilities at Risk - High Wildfire Hazard Zone	83
Table 5.2.6	Capability Matrix – City of Newport News	83
Table 5.3.1a	Significant Flood Events – City of Williamsburg	90
Table 5.3.1b	NCDC Listed Significant Flood Events –City of Williamsburg	90
Table 5.3.2	Historic Hurricanes – City of Williamsburg	92
Table 5.3.3	Historic Tornados – City of Williamsburg	92
Table 5.3.5a	Value of Exposed Structures from HAZUS®MH – City of Williamsburg	94
Table 5.3.5b	Summary of Hurricane Probabilistic Analysis on Residential Structures – Williamsburg	95
Table 5.3.5c	Critical Facilities at Risk – High Wildfire Hazard Zone	96
Table 5.3.6	Capability Matrix – City of Williamsburg	96
Table 5.4.1a	Significant Flood Events – James City County	101
Table 5.4.1b	NCDC Listed Significant Flood Events –James City County	102
Table 5.4.2	Historic Hurricanes – James City County	103
Table 5.4.3	Historic Tornados – James City County	104
Table 5.4.5a	Total dollar value of Exposed Structures from HAZUS®MH – James City County	106
Table 5.4.5b	Summary of Probabilistic Analysis – Residential Structures – James City County	106
Table 5.4.5c	Critical Facilities at Risk - High Wildfire Hazard Zone	107
Table 5.4.6	Capability Matrix – James City County	107
Table 5.5.1a	Significant Flood Events – York County	114
Table 5.5.1b	NCDC Listed Significant Flood Events –York County	115
Table 5.5.2	Historic Hurricanes – York County	117
Table 5.5.3	Historic Tornados – York County	118
Table 5.5.5a	Value of Exposed Structures from HAZUS®MH – York County	121
Table 5.5.5b	Summary of Probabilistic Analysis – Residential Structures – York County	122
Table 5.5.5c	Recent Winter Storms – York County	123
Table 5.5.5d	Critical Facilities at Risk – 100-Year Floodplain	124
Table 5.5.5e	Critical Facilities at Risk – Surge Zone Hurricane Category 4	125
Table 5.5.5f	Critical Facilities at Risk – High Wildfire Hazard Zone	126
Table 5.5.6	Capability Matrix – York County	127
Table 6.1.2a	Committee Voting Results on Mitigation Measures	148
Table 6.1.2b	Mitigation Measures Prioritized	149
Table 6.3	Categorizing Action Items by Goal and Objective	151

LIST OF FIGURES

		PAGE
Figure 2.0	Peninsula Vicinity Map	7
Figure 4.1.3	Significant Tropical Storm Systems, Virginia Peninsula	26
Figure 4.1.6	Virginia Lightning Strike Density Map for 1989 Only(State Climatology Office)	34
Figure 4.1.7	Winter Storm	34
Figure 4.1.8	Greatest Number of Consecutive 100°F Days	37
Figure 4.1.11	U.S. Drought Monitor, August 20, 2002	41
Figure 4.1.12	Virginia Peninsula Seismic Risk	42
Figure 4.1.13	National Lyme Disease Risk Map	49
Figure 5.6	Evacuation Zones	137

LIST OF APPENDICES

Appendix A	Hazard Mitigation Planning Committee Member List
Appendix B	Hazard Specific Mapping
Appendix C	Catalog of Virginia's Historical Hurricane
Appendix D	Hazard Ranking Sheets
Appendix E	Critical Facilities Inventory
Appendix F	Multi-Hazard Mapping – Large-Format Maps
Appendix G	Alternative Multi-Hazard Mitigation Actions
Appendix H	Criteria for Selecting Mitigation Measures
Appendix I	Public Meeting Notices and Community Resolutions of Adoption
Appendix J	Acronyms Used in This Plan
Appendix K	Public Comments and Response to Comments Memos
References	

1.0 Introduction

The Disaster Mitigation Act of 2000 (DMA 2000), approved by Congress and signed into law (Public Law 106-390) in October 2000, is a key component of the Federal government's attempt to reduce the rising cost of disasters in the United States. The Act establishes the Pre-Disaster Hazard Mitigation Program (PDM) and new requirements for the post-disaster Hazard Mitigation Grant Program (HMGP). It emphasizes the importance of mitigation planning in communities.

In an effort to highlight the importance of planning in the mitigation process, the DMA 2000 law requires local governments to develop and submit natural hazard mitigation plans in order to qualify for PDM and HMGP grant funding. Specifically, the Act requires that the plan demonstrate "a jurisdiction's commitment to reduce risk from natural hazards, serving as a guide for decision makers as they commit resources to reducing the effects of natural hazards." The final plan must be adopted by the jurisdiction and then approved by the Federal Emergency Management Agency (FEMA).

In order to facilitate DMA 2000 compliance for its member jurisdictions, the Peninsula Hazard Mitigation Planning Committee (PHMPC) developed a Natural Hazard Mitigation Plan pursuant to the requirements of DMA 2000. The Peninsula's hazard mitigation planning process also incorporated steps to meet the requirements of the Flood Mitigation Assistance (FMA) program, which will qualify its member jurisdictions for additional Federal flood mitigation assistance.

Hazard mitigation, defined, is any sustained action taken to reduce or eliminate long-term risk to human life and property from hazards. Planning is the process of setting goals, developing strategies, and outlining tasks and schedules to accomplish these goals. In preparing this plan, the PHMPC identified the natural hazards that threaten their jurisdictions, determined the likely impacts of those hazards, and assessed the vulnerability of the communities to the studied hazards. The PHMPC also assessed their capability to address those hazards through the existing programs and policies. The PHMPC then set mitigation goals and prioritized appropriate strategies to lessen the potential impacts of hazard events.

1.1 Scope

The Peninsula Natural Hazard Mitigation Plan identifies goals, information, and measures for hazard mitigation and risk reduction to make the participating communities more disaster-resistant and contribute to the planning area's long-term sustainability. The plan not only addresses current concerns, but has also been developed so it can be used to help guide and coordinate mitigation activities and local policy decisions for future land use.

This plan follows FEMA's DMA 2000 planning requirements and associated guidance for developing Local Hazard Mitigation Plans. The guidance sets forth a four-task mitigation planning process:

- organize resources,
- assess hazards and risks,
- develop a mitigation plan, and
- evaluate your work.

The plan also utilizes the criteria set forth in FEMA's Crosswalk Reference Document for Review and Submission of Local Mitigation Plans.

1.2 Plan Organization

The Peninsula Natural Hazard Mitigation Plan is organized into seven sections. The organization of the plan is as follows:

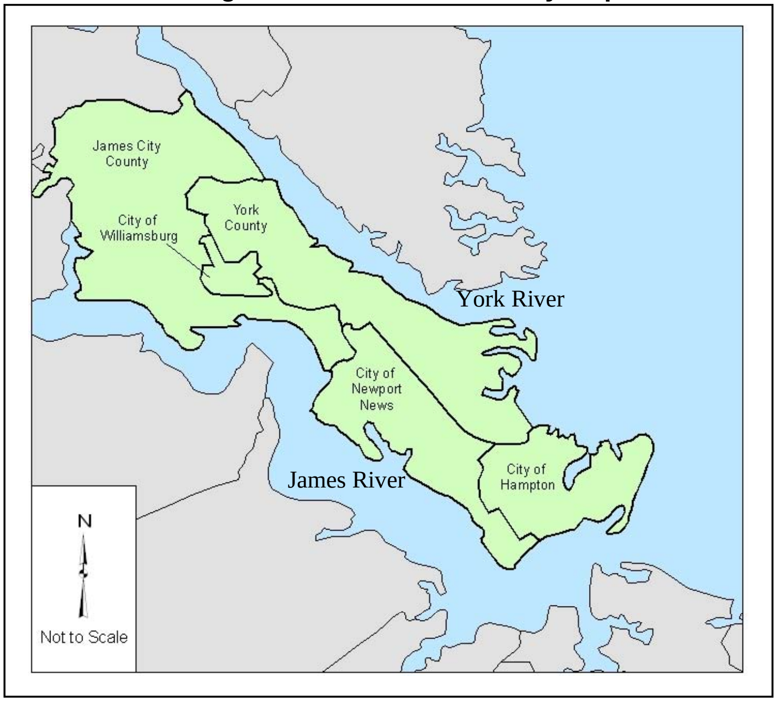
Table 1.2 -Plan Organization

Section Number	Title
1.0	Introduction
2.0	Regional Profile
3.0	Planning Process
4.0	Regional Hazard Identification and Risk Assessment
5.0	Community Specific Hazard Identification and Risk Assessment, including Regional and Community Capability Assessments 5.1 City of Hampton 5.2 City of Newport News 5.3 City of Williamsburg 5.4 James City County 5.5 York County
6.0	Regional Mitigation Goals and Objectives/Specific Community Actions 6.3.1 City of Hampton 6.3.2 City of Newport News 6.3.3 City of Williamsburg 6.3.4 James City County 6.3.5 York County
7.0	Plan Implementation and Maintenance

In the future, if communities wish to create a community-specific plan, appropriate sections can be utilized.

2.0 Regional Profile

Figure 2.0-Peninsula Vicinity Map



Location

The lower Virginia Peninsula in southeast Virginia is bounded by the York River, James River, and Chesapeake Bay. The region encompasses the independent cities of Hampton, Newport News and Williamsburg, and includes James City County and York County. The region has extensive natural areas, including the Chesapeake Bay, picturesque rivers, state parks, wildlife refuges, and botanical gardens.

This Peninsula is rich in colonial American history. The first permanent English settlement in North America was established in 1607 at Jamestown, in James City County. Virginia's first capital was in Williamsburg and much of the historic district of that city has been restored. Also, the decisive battle of the American Revolution, the Battle of Yorktown in 1781, took place on the Virginia Peninsula. In 1862 during the American Civil War, the Union Army invaded the Peninsula as part of the campaign to capture Richmond. The 1862 Battle of Yorktown took place along the York River.

The Peninsula jurisdictions are part of the Virginia Beach, Norfolk, Newport News, Virginia, North Carolina Metropolitan Statistical Area (MSA). The Virginia portion of this MSA is generally termed Hampton Roads. The land portion of Hampton Roads is divided into two regions: the Peninsula, on the north, and South Hampton Roads, on the south side, where the majority of the area's population resides.

Hampton Roads is an important area of water-based commerce, especially for the cities of Norfolk, Portsmouth, and Newport News. The Norfolk Naval Shipyard is located in Portsmouth a few miles up the Elizabeth River. Northrup Grumman Shipyard is located near the mouth of the James River in Newport News. There are also several smaller shipyards, numerous docks and terminals. Massive coal loading piers and facilities were established in the late 19th and early 20th century by the Chesapeake & Ohio (C&O), Norfolk & Western, and Virginian Railways at the end of the Peninsula in Newport News. CSX Transportation now serves the former C&O facility at Newport News.

Population Growth and Development Trends

Bordered by the York River to the north, James River to the south, Hampton Roads, and the Chesapeake Bay to the east, the Lower Virginia Peninsula is home to more than 450,000 people. (Weldon Cooper 2005) Future population projections indicate that the area will have more than 540,000 residents by 2030. (Virginia Employment Commission, 2005)

The Peninsula region has been one of Virginia's fastest growing regions in recent years. Between the 1990 and 2000 Census, the population of the region grew by 12.8 percent (see Table 2a). Population projections since the 2000 Census, completed by the Weldon Cooper Center for Public Service at the University of Virginia, show that the region as a whole continues to grow but at a less rapid pace.

Table 2a-Regional Population Statistics

Jurisdiction	Census Data		% change 1990 – 2000	Weldon-Cooper 2004 estimate [1]	% change 2000 to 2004	2030 Population Projection [2]
	1990	2000				
City of Hampton	133,793	146,437	9.5%	142,800	-2.48%	155,600
City of Newport News	170,045	180,150	5.9%	182,400	1.25%	190,100
City of Williamsburg	11,530	11,998	4.1%	13,600	13.35%	13,900
James City County	34,859	48,102	38.0%	55,200	14.76%	92,000
York County	42,434	56,297	32.6%	61,500	9.24%	91,000
Total	**392,649**	**442,984**	**12.8%**	**455,500**	**2.83%**	**542,600**

[1] Weldon Cooper Center, UVA 2005
[2] Virginia Employment Commission, Electronic Labor Market Access, 2005

In addition to population projections, the Weldon Cooper Center also summarizes building permits by community to provide a picture of residential construction activity by year. Building permits are categorized by type of building (single-family, 2-4 unit structures, and 5+ unit structures) and by builder-estimated value of construction. For multi-unit structures, the data indicate the number of units permitted rather than the number of buildings. The information excludes permits issued for mobile homes, garages and other out-buildings, additions and renovations, and commercial construction. These data provide insight to the amount of construction occurring in each of the team jurisdictions (see Table 2b).

Table 2b -2004 Annual Building Permit Data

Jurisdiction	Single Family Units		Structures with 2-4 Units		Structures with 5+ Units		Total Units	
	Number	Cost	Number	Cost	Number	Cost	Number	Cost
Hampton	321	$36,853,379	0	$0	0	$0	321	$36,853,379
Newport News	280	$33,347,101	0	$0	463	$26,793,361	743	$60,140,462
Williamsburg	93	$11,077,085	16	$1,090,400	0	$0	109	$12,167,485
James City	1,111	$239,382,070	0	$0	0	$0	1,111	$239,382,070
York	438	$73,474,329	36	$2,202,000	0	$0	474	$75,676,329
Total	2,243	$394,133,964	52	$3,292,400	463	$26,793,361	2,758	$424,219,725

2.1 History of the Peninsula Region

City of Hampton, Virginia

Hampton is the oldest continuously settled English-speaking community in the United States. The area now occupied by Hampton was first noted by English colonists before they sailed up the James River to settle in Jamestown, where they visited an Indian village called Kecoughtan.

In 1610 the construction of Fort Henry and Fort Charles at the mouth of Hampton Creek marked the beginnings of Hampton. In 1619, the settlers chose an English name for the community, Elizabeth City. The settlement was known as Hampton as early as 1680, and in 1705 Hampton was recognized as a town. The City of Hampton was first incorporated in 1849. In 1952, Hampton, the independent town of Phoebus and Elizabeth City County, encompassing Buckroe and Fox Hill, were consolidated under one municipal government.

Benjamin Syms and Thomas Eaton founded the first free public schools in the United States in Hampton. Hampton is the site of Hampton University, established in 1868 to educate freed slaves. St. John's Episcopal parish was founded in 1610, making it the oldest in the country.

Fort Monroe, the only active moat-encircled fort in the country, dates from 1819. For a long period during the Civil War, the fort was the only Union outpost in the Confederacy. The famous battle between the first ironclad battleships, the *Monitor* and the *Merrimac*, was fought just offshore in Hampton Roads, near the Hampton-Newport News municipal boundary.

During the Civil War, Hampton was burned down by its own troops rather than surrender to Federalist troops. Before the fire, Hampton had 30 businesses and over 100 homes. Fewer than six buildings remained intact after the fire. In 1884, fire again besieged Hampton and almost completely destroyed the downtown business district.

Hampton is now a thriving city with numerous industries including high-tech firms, seafood processing, NASA, military and tourism. Fort Monroe is currently headquarters for the U.S. Army Training and Doctrine Command but is facing closure and redevelopment as a result of the 2005 Base Realignment Closure Commission. Langley Air Force Base, where historic Langley field was constructed in 1917, is home of the First Fighter Wing. NASA Langley Research Center, where America's first astronauts were trained, is now a major center for aviation research.

City of Newport News, Virginia

Established as a town in 1880, Newport News was incorporated as a city in 1896. In the 1960s, the City of Newport News merged with Warwick County to create today's incorporated area.

The most widely accepted version of how Newport News was named relates to Captain Christopher Newport's return to the area from England in 1610. Newport met the Jamestown colonists on Mulberry Island, (located offshore on the James River) as they were preparing to return to England. The news of his arrival with three vessels, a plentiful supply of provisions and 150 men, gave heart to the dispirited colonists who agreed to go back to Jamestown. In gratitude, they named the point of landing "Newport's News." Over the years, the "s" was dropped, thus the name Newport News.

Newport News played a major role in the Peninsula Campaign during the Civil War. Numerous earthen fortifications and attractions that relate to the Civil War are still visible. Additionally, the famous Battle of the Ironclads took place off the shores of Newport News in 1862. Collis P. Huntington, a Northern railroad tycoon from Connecticut, established two major industries in Newport News: the Chesapeake and Ohio Railroad and Newport News Shipbuilding. Newport News Shipbuilding and Dry Dock Company, established in 1886, built many of the United States' aircraft carriers, including the *Enterprise*, *Kennedy, Washington*, *Vinson,* and *Roosevelt*. On Nov. 7, 2001, Newport News Shipbuilding signed a merger agreement with Northrop Grumman, and officially became Northrop Grumman Newport News.

The U.S. Army designated Newport News as a Port of Embarkation immediately after America's entry into World War I. The final major military base during WWI was Camp Eustis, which later became known as Fort Eustis. Named after the founder of Fort Monroe's Artillery School of Practice and a War of 1812 veteran, Brigadier General Abraham Eustis, the camp was created in 1918 to meet the need for an artillery firing range. Today, Fort Eustis is the home of the U.S. Army Transportation Corps, and the Transportation Corps Regiment. The U.S. Army Transportation Museum is also located at Fort Eustis.

City of Williamsburg, Virginia

In 1699, the General Assembly of Virginia established the City of Williamsburg as the colony's capital. The new city, formerly known as Middle Plantation, was named in honor of King William III. In 1722, King George I granted a royal charter incorporating the City of Williamsburg after the fashion of the English municipal borough.

During the 1700's, Williamsburg developed into a bustling capital city and played a singularly historic role in events leading to American Independence. In 1780, the capital of Virginia moved to Richmond, and the Williamsburg area reverted to a quiet college town and rural county seat. In retrospect, Williamsburg's loss of capital city status was its salvation. Many eighteenth century buildings survived into the early twentieth century, when John D. Rockefeller Jr. supported a massive restoration effort. Now, the center of tourism and history, the area is preserved and managed by “Colonial Williamsburg”, a non-profit foundation.

The College of William and Mary, located in Williamsburg, currently enrolls 5700 undergraduate and 2000 graduate students. Originally founded on February 8, 1693, William and Mary is the second-oldest institution of higher learning in the United States and the fourth oldest in North America. The school was one of the original Colonial colleges; the College's Wren Building is one of the oldest academic buildings in continuous use in the United States. The College educated several American leaders, including three U.S. Presidents. George Washington served as one of the College's first Chancellors.

William and Mary was occupied during the Civil War and closed from 1882-1888 due to financial strains (the College had invested in some Confederate bonds). In 1888, William and Mary reopened its doors and began to expand. Today, William and Mary is one of Virginia's most-cherished universities and was one of the first universities to become coeducational in 1918. William and Mary is consistently ranked among the premier public universities in America.

James City County, Virginia

On May 13, 1607, 144 English explorers arrived and soon established James Towne as the administrative center or capitol. In 1634, by order of the King of England, Charles I, eight shires or counties with a total population of approximately 5,000 inhabitants were established in the colony of Virginia. James City Shire, as well as the James River and Jamestown took their name from King James I, the father of King Charles I. About 1642-43, the name of the James City Shire was changed to James City County. The original county included what is now Surry County across the James River, part of Charles City County and some of New Kent County.

Williamsburg became an independent city from James City County in 1884; however, the city is still the county seat of James City County, and they share a school system, courts, and some constitutional officers.

James City County encompasses land important in the early history of our nation. Three jurisdictions, James City County, York County, and the City of Williamsburg, work collaboratively on policies, programs, infrastructure and land use to preserve this historic area.

York County, Virginia

York County, named for King Charles I, was formed in 1634 as Charles River Shire. It was one of the eight original shires in the Colony of Virginia. The county was renamed in 1642-43 as York County. The river, county, and town are believed to have been named for York, a city in Northern England. The first courthouse and jail were located near what is now Yorktown, although the port used for shipping tobacco to Europe was variously called Port of York, Borough of York, York, or Town of York, until Yorktown was established in 1691. Never incorporated as a town, Yorktown is the county seat of York County. The only town ever incorporated within the county's boundaries was Poquoson, which was incorporated in 1952 and became an independent city in 1975.

York County is most famous as the site of the surrender of General Cornwallis to General George Washington in 1781, ending the American Revolutionary War. Yorktown also figured prominently in the Civil War, serving as a major port to supply both northern and southern towns, depending upon who held Yorktown at the time.

Yorktown is part of an important national resource known as the Historic Triangle of Yorktown, Jamestown and Williamsburg, and is the northern terminus of the Colonial Parkway.

3.0 Planning Process

The Peninsula Group retained AMEC Earth & Environmental (AMEC) to assist with the facilitation and development of the region's Multi-Jurisdictional Mitigation Plan. AMEC assisted the region with the following tasks and processes:

- Establishment of the Peninsula Hazard Mitigation Planning Committee (PHMPC),
- Meeting all of the DMA and FMA requirements as established by federal regulations and in accordance with FEMA's planning guidance,
- Facilitation of the planning process,
- Identification of the data requirements and conduct of the research and documentation necessary to augment that data,
- Development and facilitation of the public input process,
- Production of the draft and final plan documents, and
- Submission for acceptance by the Virginia Department of Emergency Management (VDEM) and FEMA Region III.

AMEC assisted the PHMPC with the establishment of the process for this planning effort utilizing the DMA 2000 planning requirements, and FEMA's associated guidance. In addition, AMEC's planning process also incorporated another 10-step planning process that satisfies the planning requirements of several other federal programs, including the U.S. Army Corps of Engineers' Floodplain Management Planning, the Community Rating System (CRS) of the National Flood Insurance Program (NFIP), and FEMA's FMA program. The approach for these programs follow the steps shown Table 3 juxtaposed with the DMA 2000 requirements. The PHMPC followed this process in developing this plan.

Disaster Mitigation Act Planning Regulations (44 *CFR* 201.6)	**CRS / FMA Planning Steps**
Planning Process	
201.6(c)(1)	1. Organize
201.6(b)(1)	2. Involve the public
201.6(b)(2) & (3)	3. Coordinate
Risk Assessment	
201.6(c)(2)(i)	4. Assess the hazard
201.6(c)(2)(ii) & (iii)	5. Assess the problem
Mitigation Strategy	
201.6(c)(3)(i)	6. Set goals
201.6(c)(3)(ii)	7. Review possible activities
201.6(c)(3)(iii)	8. Draft an action plan
Plan Maintenance	
201.6(c)(5)	9. Adopt the plan
201.6(c)(4)	10. Implement, evaluate, revise

Table 3a- DMA 2000/CRS Planning Requirements

Local Government / Community Participation

The DMA planning regulations and guidance stress that each local government seeking the required FEMA approval of their mitigation plan must:

- Participate in the process,
- Detail areas within the Planning Area where the risk differs from that facing the entire area,
- Identify specific projects eligible for funding, and
- Have the governing boards adopt the plan.

To help define the participation process in this plan, the PHMPC further defined participation as:

- Attendance at the Hazard Mitigation Planning Committee meetings,
- Providing data that was requested by the Planning Committee,
- Reviewing and providing comments on draft plans,
- Advertising, coordinating, and participating in the Public Input elements, and
- Coordination of plan adoption by the individual communities.

The following pages describe the planning process in further detail.

Table 3b -PHMPC Meeting Focus

PHMPC Mtg. #	Date	Meeting Focus
1	10-28-04	Kick-off: plan purpose and scope, planning process explanation, role of participating communities, PHMPC composition, public input strategy, and coordination with other agencies, stakeholders, and community plans. 35 members attended. Held in James City County.
2	12-07-04	Reviewed data collection methods and requirements for HIRA and Capability Assessment, conducted prioritization of hazards exercise for each community; 40 members attended. Held in Newport News.
3	02-01-05	Reviewed Draft #1, marked up large format maps w/problem areas, reviewed and established goals and objectives through "card-storming," 35 members attended. Held in Williamsburg.
4	03-01-05	Reviewed goals and objectives, reviewed/discussed alternative mitigation measures, brainstormed recommended mitigation measures from alternatives. 29 members attended. Held in York County
5	03-02-05	Reviewed mitigation measure selection criteria, prioritized mitigation measures using criteria (and "dot" voting system), developed detailed mitigation recommendations with scheduling information, funding sources, and detailed problem descriptions. 25 HMPC members attended. Held in Hampton.
6	06-22-05	Distributed hard copies of the Draft #2; reviewed Recommended Action Plans for each community and discussed each with PHMPC; reviewed schedule and planned next set of Public Meetings, reviewed of multi-hazard mapping (large format); and discussed adoption process. 24 members attended. Held in Hampton
7	10-18-05	Review of Public & PHMPC comments from Draft #3

Step 1: Get Organized – Building the Planning Team

The PHMPC was comprised of key Peninsula and local stakeholder representatives. The Deputy Coordinator of the Office of Emergency Management of the City of Newport News led the team. The first step was to establish both a framework and organization for the development of this Plan. The Committee met seven times over a one-year period. Typical attendees at each meeting included representatives from the police, fire, planning, public works, utilities, emergency management, school system and finance departments, as well as VDEM. A list of Committee members is included in Appendix A. Invitees, attendance and agendas for each of the Committee meetings are on file at the Newport News Emergency Management office in the City of Newport News. The Committee will remain intact for the purpose of implementing and updating this plan.

Step 2: Plan for Public Involvement – Engaging the Public

An open public planning process was utilized that provided opportunities for the public and stakeholders to comment on the plan at all stages of its formation. At the first PHMPC Meeting in November 2004, the plan for public involvement was discussed and agreed upon. Committee meeting schedules, minutes, and plan updates were posted on each of the community's web pages at www.hampton.gov/eoc, www.newportnews.va.us/eoc/index.htm, http://www.james-city.va.us/, www.yorkcounty.gov/, www.ci.williamsburg.va.us/. All articles, press releases and Internet postings are on file with the City of Newport News Office of Emergency Management.

Table 3c –Public Input Meeting Dates

Public Meeting #	Date	Location
1	02-16-05	James City County
2	02-17-05	York County
3	02-28-05	Hampton
4	06-22-05	Newport News
5	06-27-05	James City County
6	06-23-05	Hampton
7	11-1-05	Williamsburg
8	11-2-05	York County
9	11-3-05	Newport News

A series of nine public meetings, spread across the various jurisdictions, were held to take comments on the draft hazard mitigation plan. Numerous press releases were provided, as well. The first releases coincided with the presentation to the public of the draft plans, and the last coincided with the announcement of the adoption of the plan by all the communities involved in the process.

Step 3: Coordinate with other Departments and Agencies

Early in the planning process, the Committee determined that the participation of other state and federal agencies would be beneficial in the data collection, mitigation and action strategy development, and plan approval process. Representatives from the following key agencies and local military instillations were invited to participate on the Committee:

- Virginia Department of Conservation and Recreation (VDCR),
- Virginia Department of Emergency Management Region 5 (Mitigation Planning Division),
- Coast Guard Training Center Yorktown,
- FEMA Region III (Mitigation Planning Division),
- Fort Eustis,
- Fort Monroe,
- Langley Air Force Base,
- National Weather Service (Wakefield Office), and
- Naval Weapons Station Yorktown.

Project managers invited representatives from Hampton University, Thomas Nelson Community College, the College of William & Mary, and the Southeast Community Redevelopment Office. Businesses were invited to participate in the team planning process through an invite extended to the Peninsula Chamber of Commerce. Non-profits were included through the public comment periods and notifications in local newspapers. Letters of invitation for each of the Committee meetings are on file at the Newport News Emergency Management office.

In addition to the agencies listed above, the Committee used the resources of the agencies set forth below in the development of this plan. Specifically, technical data, reports, and studies were obtained from these agencies either through web-based resources or directly from the agencies themselves:

- Virginia Department of Conservation and Recreation (DCR),
- Virginia Department of Emergency Management (VDEM),
- Virginia Department of Forestry (VDOF),
- Virginia Department of Health (VDH),
- Virginia Department of Mines, Minerals, and Energy,
- Virginia Soil and Water Conservation (VS&WC),
- Federal Emergency Management Agency (FEMA),
- National Oceanic and Atmospheric Association (NOAA),
    - National Climatic Data Center (NCDC),
    - National Weather Service (NWS), and
- U.S. Geological Survey (USGS).

Relationship to Other Community Planning Efforts and Hazard Mitigation Activities
Coordination with other community planning efforts is paramount to the success of a hazard mitigation plan. Hazard mitigation planning involves identifying existing community policies, tools, and actions that will reduce a community's risk and vulnerability to natural hazards. The Committee identified a variety of comprehensive planning mechanisms such as land use or master plans, emergency response plans, mitigation plans, municipal ordinances and building codes that guide and control community development. Cross-referencing existing planning efforts, mitigation policies, and action strategies into this Hazard Mitigation Plan links the specific natural hazards that present a risk to the community with the existing mitigation elements found in other community programs, other planning documents, and regulations. The development of this plan utilized information included in the following community plans, studies, reports, and initiatives:

- Municipal Comprehensive Plans from Peninsula area localities,
- Codified Ordinances from Peninsula area localities,
- Virginia Uniform Statewide Building Code – 2000,
- 2003 Hurricane Isabel Damage Assessment Reports,
- Peninsula area Tax Assessor and Land Use data, and
- Flood Insurance Study and Flood Insurance Rate Maps for the Peninsula region.

Through implementation of this plan appropriate data and recommendations of this plan will be integrated into the other existing community activities.

The following sections of this plan complete the ten-step planning process;

- Section 4.0- Hazard Identification and Risk Assessment is step 4: Assess Hazard
- Section 5.0-Community Specific Profiles is step 5: Assess the Problem
- Section 6.0-Mitigation Goals and Objectives are Step 6: Set Goals, Step 7: Review Possible Activities, and Step 8: The Action Plan.
- Section 7.0-Plan Implementation includes Step 9: Plan Implementation and Step 10: Plan Maintenance

4.0 Hazard Identification and Risk Assessment

This section of the plan includes a summary discussion of natural hazards that could potentially impact the Peninsula region. General hazard histories and vulnerability across the entire region, for both critical and non-critical hazards, are discussed with minimal reference to individual communities. For the purposes of mitigation planning, critical hazards are defined as those hazards for which historical data exists to document impacts that have resulted in losses to the community and its' citizens. Non-critical hazards are hazards that have occurred very infrequently or have not occurred at all in the historical data. Non-critical hazards are not considered a widespread threat resulting in significant losses of property or life. Hazard losses, historical data, and some anecdotal evidence of severity are included in this section.

Section 5 furthers the risk assessment by providing a more detailed community-specific evaluation of the critical hazards and their potential impact. Each community's risk assessment contains a summary of historical information on natural hazard losses and a detailed vulnerability assessment. The vulnerability assessment uses data available in the communities to define the hazard in terms of a metric. In this case, the metric used are the assets at risk by dollar value as established by local property assessments. The vulnerability of critical facilities is also provided. FEMA defines critical facilities as those facilities that warrant special attention in preparing for a disaster, and/or facilities that are of vital importance to maintaining citizen life, health, and safety during and/or directly after a disaster event. A final component of the risk assessment is capability assessment of existing programs and mechanisms in place to mitigate the effects of natural hazards completes the overall risk assessment. This helps determine appropriate mitigation actions by taking into account those measures that already exist.

In summary, Sections 4 and 5 identify hazards that have potential to adversely affect the jurisdictions. By quantifying potential impacts through the vulnerability analyses, and outlining existing protective measures that lessen those impacts through the capability analysis, a net vulnerability is determined. The plan's goals and objectives are then based on this net vulnerability.

4.1 Hazard Identification

The PHMPC for the Peninsula conducted a Hazard Identification study to determine which hazards threaten the planning area communities. The natural hazards identified and investigated in the Peninsula region included the following:

- Flooding
- Hurricanes & Tropical Storms
- Tornados
- Nor'easters
- Thunderstorms
- Winter Storms
- Extreme Heat
- Dam Failure
- Wildfire
- Drought
- Earthquakes
- Biological Hazards/Epidemics
- Landslides
- Expansive Soils
- Tsunamis

Historical data was collected for all hazard types. By examining the historical occurrence of each hazard, along with the impacts, the PHMPC was able to identify the critical hazards; those that pose the most significant risks to the region. This allowed the PHMPC to focus its mitigation planning efforts on those critical hazards. Prioritizing the potential natural hazards that threaten the Peninsula area required analysis of two factors: the probability that a certain type of natural hazard will affect the region and the potential extent and severity of the damage caused by that hazard. The probability of occurrence for each hazard was determined using existing technical analyses, such as the FEMA Flood Insurance Study. When data was not available, the probability was based on the history of events.

There have been 34 presidential disaster declarations in Virginia between 1953 and September 2005 (Table 4.1) with eight having direct impacts on the Peninsula.

Table 4.1 -Presidential Disaster Declarations in Virginia, 1953 –2005

Declaration Number	Month	Year	Description	Impacted Peninsula
274	August	1969	Hurricane Camille (flooding); 27 jurisdictions declared, but none on the Peninsula	
339	June	1972	Hurricane Agnes (flooding); 106 jurisdictions declared	✓
358	September	1972	Storm/Flood; Hampton and Newport News declared	✓
359	October	1972	Flood; Western, Central, Southeastern Virginia; 31 jurisdictions declared	
531	April	1977	Flash Flood; Southwestern Virginia; 16 jurisdictions declared	
543	November	1977	Flood; Southwestern Virginia; 8 jurisdictions declared	
593	July	1979	Flood; Buchanan County declared	
606	September	1979	Flood; Patrick County declared	
707	May	1984	Flood; Buchanan, Dickinson & Washington Counties declared	
755	November	1985	Flood; Western, Central Virginia; 52 jurisdictions declared	
847	October	1989	Flood; Buchanan County declared	
944	April	1992	Flood; Western Virginia; 24 jurisdictions declared	

Declaration Number	Month	Year	Description	Impacted Peninsula
1007	**December**	**1993**	Severe Storm; Tornado	
1014	**February**	**1994**	Ice Storm; Central, Western Virginia; 71 jurisdictions declared	
1021	**March**	**1994**	Ice Storm; Central, Western Virginia; 29 jurisdictions declared	
1059	**June**	**1995**	Flood; Central & Western Virginia; 24 jurisdictions declared	
1086	**January**	**1996**	Blizzard; all counties and cities in state declared.	✓
1098	**January**	**1996**	Flood; 27 jurisdictions declared	
1135	**September**	**1996**	Hurricane Fran (flooding); 88 jurisdictions declared	
1242	**August**	**1998**	Hurricane Bonnie (flooding); 5 jurisdictions declared	
1290	**September**	**1999**	Hurricane Dennis; Hampton declared	✓
1293	**September**	**1999**	Hurricane Floyd (flooding); 48 jurisdictions declared, including Peninsula communities	✓
1318	**February**	**2000**	Winter Storms; 107 jurisdictions declared, including Williamsburg, JCC and York Co	✓
1386	**July**	**2001**	Flood; Southwestern Virginia; 10 jurisdictions declared	
1392	**September**	**2001**	Pentagon Attack; 1 jurisdiction declared	
1406	**March**	**2002**	Flood; Southwestern Virginia; 10 jurisdictions declared	
1411	**April/May**	**2002**	Flood; Southwestern Virginia; 9 jurisdictions declared	
1458	**February**	**2003**	Winter Storms/Flooding; 39 jurisdictions declared	
1491	**September**	**2003**	Hurricane Isabel (winds, flooding); 100 jurisdictions declared, including Peninsula communities	✓
1502	**November**	**2003**	Flood; Southwestern Virginia; 6 jurisdictions declared	
1525	**May**	**2004**	Flood; Southwestern Virginia; 3 jurisdictions declared	
1544	**September**	**2004**	Flood; Central Virginia; 12 jurisdictions declared	
1570	**October**	**2004**	Flood; Southwestern Virginia; 10 jurisdictions declared	
3240	**September**	**2005**	Hurricane Katrina Evacuation; all Peninsula communities declared	✓

Source: VDEM and FEMA web sites.

4.1.1 Multi-Hazard Correlation

While this plan investigates individual hazard history and occurrence, it should be noted that many hazards occur simultaneously or in sequences that result in other subsequent hazards. For example, hurricanes are defined by sustained wind speed but not all hurricane damage is from wind. Heavy rains associated with these storms and storm surge generated by waters piled up on shore result in devastating flooding. The effects of natural hazards can last years after the initial damage events. High wind events blow down trees, which can increase the wildfire hazard for years to come due to an increase in downed dead or dying woody debris. In addition, uprooted trees in low-lying or typically damp areas can cause other problems. For example, the root bulb from the fallen tree can excavate large holes in the landscape, which when filled the rainwater can provide breeding grounds for mosquitoes. Another example would be the clogging of drainageways and culverts by the fallen trees.

Although the effects of storm surge can be the most devastating of a tropical system, storm surge is unlikely to occur without the existence of a tropical storm or hurricane. Therefore, storm surge is discussed below as a secondary hazard associated with tropical systems. Erosion in the Peninsula region is typically associated with nor'easters and can also be a secondary effect of sea level rise. Additional detail on the erosion hazard is included in the nor'easter and sea level rise descriptions below.

4.1.2 Flooding

Flooding is the most frequent and costly natural hazard in the United States. Approximately 80 percent of presidential disaster declarations result from natural events in which flooding is a major component. Excess water from snowmelt, rainfall, or storm surge accumulates and overflows onto adjacent floodplains—lowlands adjacent to rivers, lakes, and oceans that are subject to recurring floods. While many floodplain boundaries are mapped by FEMA's National Flood Insurance Program (NFIP), floods sometimes go beyond the mapped floodplains or change courses due to natural processes (e.g., accretion, erosion, sedimentation) or human development (e.g., filling in floodplain or floodway areas, increased imperviousness within the watershed from new development, or waterway blockage from debris including: trees, cars, trailers, and propane tanks).

There are four types of flooding in Virginia: coastal flooding, urban flooding, flash flooding, and river flooding. Due to its geographic location within the coastal plain and its rapid population growth, the Peninsula area is susceptible to all four types of flooding.

Coastal Flooding
Coastal flooding (or tidal flooding) results from higher than average tides along coastal areas. This usually occurs during passing tropical systems and nor'easters. The high winds produced by these events can pile water on the shorelines. If this occurs at the time of the astronomical high tide, the flooding is amplified and will inundate low-lying areas along the shorelines.

Urban Flooding
Urban flooding occurs in heavily developed areas where impervious surfaces do not allow water to be absorbed into the ground, thereby increasing the amount of water runoff. If areas are without proper drainage, or storm drains become clogged, then streets become streams and water will gather in low-lying areas. If it rains hard enough, underpasses can rapidly fill, trapping

motorists. Streets can accumulate enough water to submerge cars or carry them wherever the water flows.

Flash Flooding

Flash floods occur in a short period of time, or in a "flash". Rain falls at such a high rate that water does not have time to soak into the ground. Runoff flows downhill into ditches, lowlands and small streams. As the heavy rain continues, ditches overflow, drains backup, water ponds in lowlands, and streams rise over their banks. Streams and creeks can become raging rivers in just minutes. People are often caught off guard, especially motorists. Half of flash flood deaths in the United States are in automobiles.

River Flooding

River floods occur when heavy rains fall over a large area. In many cases in Virginia, it begins as widespread flash flooding of small streams. About 60 percent of Virginia's river floods begin with flash flooding from tropical systems passing over or near the state. River flooding also occurs as a result of successive rainstorms. Rainfall from any one storm is generally not enough to cause a problem, but with each successive storm's passage over the basin, the river rises until eventually it overflows its banks. If it is late winter or spring, melting snow in the mountains can produce added runoff that can compound flood problems.

Frequent flash flooding and urban flooding on the Peninsula is often caused by powerful thunderstorms that can dump one to four inches of rain in a few hours. Small creeks and streams as well as over-burdened drainage systems often cannot cope with the rapid influx of rain waters, especially when runoff is increased through urbanization of the watershed, or poor infiltration of precipitation due to overly wet or dry soils. The banks of non-tidal streams may quickly overtop, resulting in flooded roads and intersections and occasional property damage. The topography of much of the Peninsula is relatively flat and low-lying, which further hinders effective disbursement of runoff. Additional discussion regarding urban flooding and specific problem areas is included in Section 5 through detailed descriptions for each community.

4.1.3 Hurricanes and Tropical Storms

A hurricane is a type of low-pressure system, which generally forms in the tropics; similarly, a tropical storm is a low-pressure system of less intensity than a hurricane. Tropical systems are an important part of the atmospheric circulation system, distributing heat from the equatorial region to the higher latitudes. Hurricane season in the North Atlantic generally runs from June 1st until November 30th, with the peak season between August 15th and October 15th. Winds of a hurricane blow in a large, counter-clockwise spiral around a relatively calm center of extremely low pressure known as the eye. Around the rim of the eye, winds are most intense and may gust to more than 200 mph in a very strong storm.

Once a hurricane has formed, they maintain themselves by extracting heat energy from the ocean at high temperatures and releasing heat at the low temperatures of the upper troposphere. Hurricanes and tropical storms are violent systems that bring heavy rainfall, storm surge, high winds and may spawn tornados, all of which can cause significant damage. These storms can last for several days; however, the average hurricane duration is 12 to 18 hours. The duration and vast area impacted create the potential for sustained flooding, high wind, and erosion conditions across several states. While wind speeds can be expected to reduce by 50 percent within 12 hours of landfall, these storms are capable of producing a large amount of rain in a short period over a wide area.

Residents and emergency managers on the Peninsula are particularly interested in the track of any approaching storm. Proximity, direction, and strength are important factors when determining response measures, evacuation needs, and potential damage from the storm. When hurricanes approach land, forecasters often describe them as having four distinct quadrants: right-front, right-rear, left-front, and left-rear. The quadrants are relative to the hurricane's overall direction of motion and are significant in evaluating damage potential. The right-front quadrant generally causes the most destruction at the coast because the winds have an additive effect of sustained on-shore winds plus the motion of the hurricane. Onshore winds are strongest in the right-front quadrant; therefore, the surge and waves in that section are also the highest.

In 1971, wind engineer Herbert Saffir and hurricane expert Dr. Robert Simpson developed a scale to classify hurricanes. The Saffir-Simpson scale rates the intensity of hurricanes based on wind speed and barometric pressure measurements. The National Weather Service uses the scale to predict potential property damage and flooding levels from imminent storms. Although the scale assigns a wind speed and surge level to each category of storm, in recent years, there has been more and more recognition of the fact that wind speed, storm surge and inland rainfall are not necessarily of the same intensity for a given storm. Therefore, there is some interest in classifying hurricanes by separate scales according to each of these risks. However, the Saffir-Simpson Scale is still the most widely used classification tool for hurricanes. The scale is outlined in Table 4.1.3. Over time, researchers and meteorologists have further refined the analysis of the wind damage that hurricanes can produce by differentiating the concept of sustained winds from peak gusts. Sustained winds are measured over longer periods of time, typically a minute. A peak gust is the highest 2 to 5 second wind speed.

Table 4.1.3-Saffir-Sampson Scale

Category	Sustained Wind Speeds (mph)	Tidal Surge (ft)	Pressure (mb)	Typical Damage
Tropical Depression	<39	--	--	
Tropical Storm	39-73	--	--	
Hurricane Category 1	74-95	4-5	> 980	*Minimal* – Damage is done primarily to shrubbery and trees, unanchored manufactured homes are damaged, some signs are damaged, no real damage is done to structures on permanent foundations.
Hurricane Category 2	96-110	6-8	965-980	*Moderate* – Some trees are toppled, some roof coverings are damaged, major damage is done to manufactured homes.
Hurricane Category 3	111-130	9-12	945-965	*Extensive Damage* – Large trees are toppled, some structural damage is done to roofs, manufactured homes are destroyed, and structural damage is done to small homes and utility buildings.
Hurricane Category 4	131-155	13-18	920-945	*Extreme Damage* – Extensive damage is done to roofs, windows, and doors, roof systems on small buildings completely fail, some curtain walls fail.
Hurricane Category 5	> 155	> 18	< 920	*Catastrophic Damage* – Roof damage is considerable and widespread, window and door damage is severe, there are extensive glass failures, some buildings fail completely.

Storm Surge

The communities involved in this planning effort are particularly exposed to the high winds and storm surge associated with hurricanes due to the coastal topography and the large bodies of water surrounding the Peninsula. The greatest potential for loss of life related to a hurricane is from the storm surge. Storm surge is simply water that is pushed toward the shore by the force of the winds swirling around the storm. This advancing surge combines with the normal tides to create the hurricane storm tide, which can increase the mean water level 15 feet or more. In addition, wind waves are superimposed on the storm tide. This rise in water level can cause severe flooding on the Peninsula, particularly when the storm tide coincides with the normal high tides.

Surge maps for York County, the City of Hampton and Newport News are included in Appendix F. Surge maps for James City County are under development by United States Army Corps of Engineers (USACE). The City of Williamsburg is not considered susceptible to storm surge flooding. A surge map can provide a great deal of information if the reader understands how the maps were prepared and their intended use.

Surge maps are based upon a Sea, Lake and Overland Surges from Hurricanes (SLOSH) model and are the basis for the "hazard analysis" portion of the area’s hurricane evacuation plans. SLOSH is a computerized model run by the National Hurricane Center (NHC) to estimate storm surge heights and winds resulting from historical, hypothetical, or predicted hurricanes by taking into account: pressure, size, forward speed, track, and winds.

Hundreds of hypothetical hurricanes are simulated with various Saffir-Simpson categories, forward speeds, landfall directions, and landfall locations. An envelope of high water containing the maximum value a grid cell attains is generated at the end of each model run. These envelopes are combined by the NHC into various composites which depict the possible flooding. One useful composite is the MEOW (Maximum Envelopes of Water) which incorporates all the envelopes for a particular category, speed, and landfall direction. Another composite that is useful to emergency managers is the MOM (Maximum of the MEOWs), which combines all the MEOWs of a particular category.

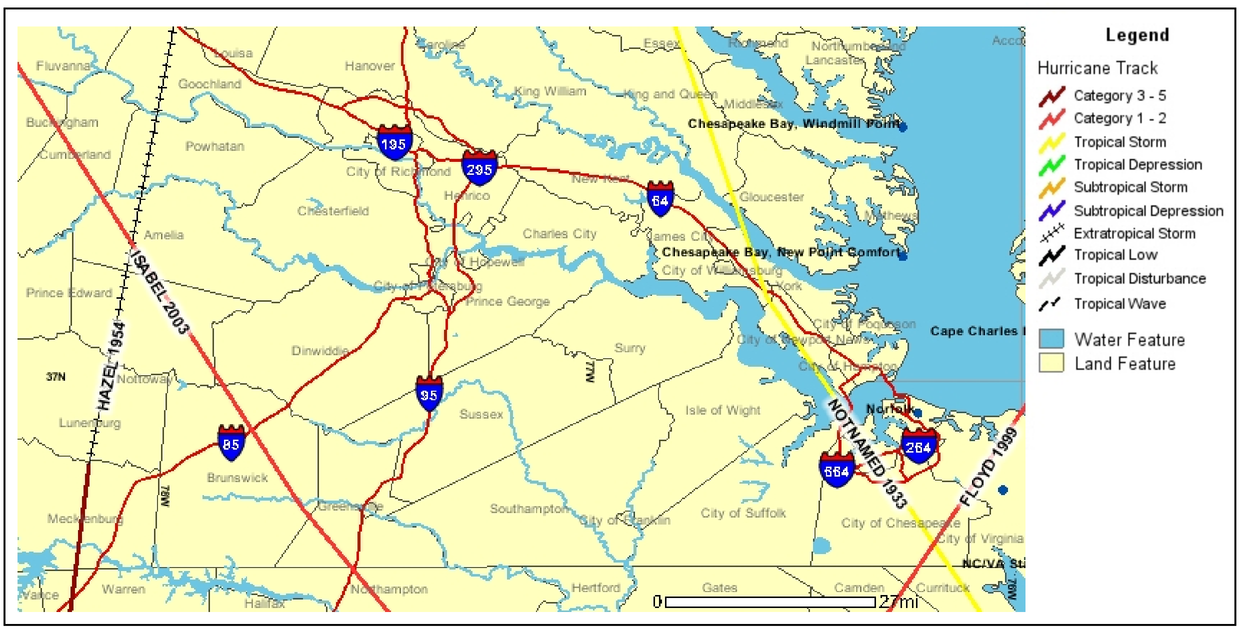
To provide some tools to emergency managers, regional evacuation studies have been completed using the SLOSH models. The MEOW maps are produced for all five levels of hurricane intensity and for many directions of storm motion, and they depict the "worse case" scenario for all categories of storms and all potential storm tracks. MEOW maps are just one tool an emergency manager will use to determine risk areas and evacuation recommendations.

The MOM (Maximum of MEOWs) storm surge maps for the Peninsula depict the "worst of the worst", and not the results of any one storm. There are no surge heights for Category Five storms because the region is generally not conducive to storms of that intensity.

History of Tropical Systems

Since 1851, 34 tropical systems have passed within 25 nautical miles of the Peninsula (see Appendix B). The Hurricane Maps and tables provided in Appendix B provide tracks and meteorological data for each of these systems. Additionally, Appendix C provides a more comprehensive set of information on individual storm events and the impacts to the Virginia coastal region as a whole. Data were obtained from a variety of sources as referenced in Appendix C. Community-specific damage information for hurricanes is provided in Section 5.

Figure 4.1.3 -Significant Tropical Storm Systems, Virginia Peninsula



Source: NOAA CSC Hurricane Mapping Tool

Figure 4.1.3 indicates the paths of particularly noteworthy tropical systems for Peninsula communities, except the 1749 storm described below. The list of noteworthy storms includes:

- **October 19, 1749,** a tremendous hurricane created Willoughby Spit, south of Hampton. The Bay rose 15 feet above normal. In Williamsburg, a family drowned as flood waters carried their house away. At Hampton, water rose to four feet deep in the streets; many trees were uprooted or snapped in two. Bodies washed ashore from shipwrecks for days afterward. Hurricane wiped out Ft. Monroe's predecessor, Ft. George.

- **Chesapeake-Potomac Hurricane, August 23, 1933,** established record high tides in many locations; approximately 9.8 feet above mean lower low water. There were four casualties on the Peninsula: two in Hampton, one in James City County, and one in York County. At Buckroe Beach in Hampton, and at Yorktown, marshal law was declared and National Guard troops were brought in to prevent looting. Flooding was severe in low-lying parts of Hampton (Fox Hill and Buckroe), York County (Goodwin Neck), and Newport News (Small Boat Basin). Jamestown Island was severely damaged.

- **Hurricane Hazel, October 15, 1954,** inflicted 130mph winds on Hampton and blew apart at least one anemometer there. There was one casualty on the Peninsula in the Dare section of York County.

- **Hurricane Floyd, September 6, 1999,** passed directly over Virginia Beach as a Category 1 Hurricane. Rainfall amounts in areas west of the Peninsula reached staggering amounts in excess of 15 inches. Prior rainfall created wet conditions that led to flooding in some parts of Newport News and Hampton.

- **Hurricane Isabel, September 18, 2003**, made landfall near Ocracoke, North Carolina as a Category 2 hurricane, and the center passed west of Emporia. Isabel brought hurricane conditions to the Peninsula and caused significant flooding, with highest tide at Sewells Point of 7.9 feet above mean lower low water, a 5 foot storm surge. There was significant beach and shore erosion along much of the Peninsula's shoreline. Grandview and Buckroe areas of Hampton, Newport News/James River waterfront, Seaford area of York County and Yorktown waterfront had many structures severely damaged by storm surge. On the Peninsula, Isabel indirectly caused one drowning death in Newport News and one debris cleanup accident fatality in York County. Statewide, the storm resulted in $1.6 billion in damages with over 1,186 homes and 77 businesses completely destroyed, 9,110 homes and 333 businesses with major damage, and over 107,000 homes and 1,000 businesses with minor damage. Hundreds of power lines were blown down leaving almost two million electrical customers without power. Crop losses were calculated to be $59.3 million with another $57.6 million in damages to farming infrastructure.

4.1.4 Tornados

Tornados are one of nature's most violent storms. A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud, circulating in a counterclockwise direction.

Tornados are spawned by a thunderstorm (sometimes as part of a hurricane) and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. The damage from a tornado is a result of the high wind velocity and wind-blown debris. Tornado season is generally March through August, although tornados can occur at any time of year. They tend to occur in the afternoons and evenings; over 80 percent of all tornados strike between noon and midnight. Tornados generally travel along squall lines, in a direction from southwest to northeast.

In an average year, about 1,000 tornados are reported across the United States, resulting in 80 deaths and over 1,500 injuries. The most violent tornados are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of one mile wide and 50 miles long. A tornado's destructive power is measured using the Fujita Damage Scale (See Table 4.1.4a). A tornado's intense power often destroys homes, downs power lines, and can cause significant tree damage.

Table 4.1.4a -Fujita Damage scale

Scale	Wind Estimate (mph)	Typical Damage
F0	< 73	Light Damage Some damage to chimneys; branches off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate Damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable Damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe Damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating Damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.
F6	319-379 mph	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies

Source: Fujita, 1971.

Most tornados on the Peninsula have occurred from June through October, and the magnitudes range from F0 to F3. The most significant tornado to strike the Peninsula in recent history was an F3 tornado in Newport News on September 5, 1979. The tornado cut a path 50 yards wide and 3 miles in length, and caused an estimated $2.5 million in property damage. In addition to tornados over land, Peninsula residents are also subject to more common waterspouts, or tornados over water. The interaction of cool coastal breezes and warm air masses over land create ideal tornado conditions when thunderstorms move over this boundary (Watson 2004c).

The tornado history compiled for Table 4.1.4b provides information on Peninsula tornados that caused significant damage, and was compiled from the NCDC database and Watson (2004b). The list begins with a storm in 1951. Quite obviously, tornados occurred on the Peninsula before 1951, but records of these storms were not readily available for the purposes of this plan. As with lighting strikes, if there is no sighting or confirmation of a tornado, inclusion in the body of tornado statistics is not likely, so this table should not be considered an all-inclusive list of tornados impacting the Peninsula.

Table 4.1.4b -Significant Historical Tornados Impacting the Peninsula

Community	Date	Magnitude	Deaths	Injuries	Property Damage	Crop Damage	Associated Tropical Cyclone?
Newport News	June 27, 1951	F1	0	0	$3K	0	No
York County	November 1, 1951	F1	0	0	$3K	0	No
Newport News	April 6, 1958	F1	0	0	$250K	0	No
Newport News	October 7, 1965	F0	0	0	$3K	0	No
Newport News	September 5, 1979	F3	0	2	$2.5M	0	Yes, David
Hampton	September 5, 1979	F2	0	9	$250K	0	Yes, David
Newport News	June 1, 1982	F0	0	0	$0K	0	No
Hampton & Newport News	August 6, 1993	F1	0	10	$5.0M	0	No
York County	July 12, 1996	F1	0	0	$15K	0	Yes, Bertha
Hampton	September 4, 1996	F0	0	0	$1K	0	Yes, Fran
Hampton	September 4, 1999	F2	0	6	$7.7M	0	Yes, Dennis
Newport News	August 11, 2001	F0	0	0	$50K	0	No
York County	August 7, 2003	F1	0	0	$20K	0	No
Hampton	August 30, 2004	Not reported	0	0	Not reported	0	Yes, Gaston

Sources: NCDC and Watson 2004b.

Appendix B contains map output from the NWS software SVRPLOT of tornado occurrences in the Tidewater region between 1950 and 2002.

4.1.5 Nor'easters

Nor'easters are coastal storms that develop off the mid-Atlantic Coast during late fall, winter and early spring. The storms are named after the direction of the prevailing winds. The storms may rapidly and unexpectedly intensify, gaining strength from the relatively warm air over the Atlantic Ocean. Simultaneously, colder air is forced southward along the East Coast. This mixture of warm and cold air can produce rain, snow, sleet, or freezing rain. The coastal plain of Virginia typically receives rain if the storm tracks over the coast or inland east of the Appalachian Mountains. When a storm center tracks east over the Atlantic Ocean, the Peninsula can receive record snowfalls.

Nor'easters generate strong northeast winds, heavy precipitation and storm surge on the Peninsula. Although the winds and storm surge associated with nor'easters are generally less intense than that of hurricanes, nor'easters can linger for several days over a given area. Storms with a long duration allow large accumulations of precipitation and damage to structures that are exposed to high wind and flooding. High-pressure systems to the north can hinder movement of the lows and serve to increase the severity of the low, thereby increasing the impacts of the storm.

The Dolan-Davis Scale (1993), Table 4.1.5a, was developed to identify and classify the damages that may occur during nor'easters. Although rarely referenced by the National Weather Service or other media in describing nor'easters (Sammler, 2005), the scale provides a useful descriptive tool for the types and levels of damage associated with a nor'easter. Heavy precipitation in the form of rain or snow, beach and dune erosion from wave action, sand/water overwash associated with storm surge, and resultant coastal property damage are all commonly associated with strong nor'easters.

Table 4.1.5a - Dolan-Davis Nor'easter Intensity Scale

Storm Class	Beach Erosion	Dune Erosion	Overwash	Property Damage
1 (Weak)	Minor changes	None	No	No
2 (Moderate)	Modest; mostly to lower beach	Minor	No	Modest
3 (Significant)	Erosion extends across beach	Can be significant	No	Loss of many structures at local level
4 (Severe)	Severe beach erosion and recession	Severe dune erosion or destruction	On low beaches	Loss of structures at community-scale
5 (Extreme)	Extreme beach erosion	Dunes destroyed over extensive areas	Massive in sheets and channels	Extensive at regional-scale; millions of dollars

Source: Davis and Dolan, 1993

Erosion

The exposed coastline of the Peninsula is subject to severe erosion during nor'easters and winter storms. Mechanical, chemical, and biological agents contribute to the wearing away or removal of coastal lands, resulting in a landward retreat of the shore. High waves and strong currents initiate coastal erosion, while breaking waves contribute to the process by suspending sediment particles and dislodging rocks. When the forces causing erosion occur at high tide, and especially during spring high tide, the resultant flooding and overwash can significantly increase the land loss and property damage. (Morton, 2003) The erosion of unconsolidated sediments and tidal wetlands throughout the Peninsula is a recurring hazard; however, private property losses and shoreline erosion are rarely quantified. The Virginia Institute of Marine Science continues to research the hazard, and maintains much data for the Gloucester Point area north of the Peninsula.

Tropical systems, nor'easters, and winter storms generate breaking waves and strong currents that have the effect of contributing new sediment to the littoral system and redistribute pre-existing sediments over large areas of the shoreface. A variety of factors, including beach composition and storm characteristics, determine how beaches are affected by storms. For example, retreat of bluffs and muddy shores occurs in an episodic, stepwise pattern without any seaward advancement between retreat events, as has historically occurred along the York River near Yorktown. Sandy beaches, like Buckroe Beach and Grandview in Hampton, tend to partially recover after storms. (Morton, 2003)

Historical Nor'easters

Almost every year, in late fall, winter or spring, the Peninsula is impacted by one or more nor'easters of varying degrees of severity. Table 4.1.5b provides a listing of historic nor'easters that have inflicted damage along the Virginia coastline, including the Peninsula. Due to the high frequency of these storms, communities on the Peninsula do not maintain detailed cost accounting for individual storms and the associated damage.

Table 4.1.5b - Historic Virginia Nor'easters

Date	Description
January 18-19, 1857	More than a foot of snow fell with temperatures in the single digits and teens across the state. Strong winds caused structural damage on land and wrecked ships at sea. One account states that Norfolk was buried under 20 foot drifts of snow. Temperatures fell to between -10° to -17° in the city. According to eyewitness accounts, the cold was so extreme that all Virginia rivers were frozen over. The Chesapeake Bay was solid ice a mile and a half out from its coast. At Cape Henry, one could walk out 100 yards from the lighthouse on the frozen ocean.
March 1-2, 1872	Known as the "Great Storm of 1872." During the evening of March 1, winds increased from the northeast to gale force (over 40 mph) on the coast and snow began blowing and drifting. It was very cold and the snow accumulated several inches. The wind drove water up into the Tidewater area and up the rivers. Water rose rapidly flooding wharves and the lower part of Norfolk.
April 11, 1956	Tidewater experienced gale winds (40 mph +) and unusually high tides. At Norfolk, the strongest gust was 70 mph. The strong northeast winds blew for almost 30 hours and pushed up the tide which reached 4.6 feet above normal in Hampton Roads. Thousands of homes were flooded by the wind-driven high water and damages were high. Two ships were driven aground. Waterfront fires were fanned by the high winds and, the flooded streets made access for firefighters very difficult, adding to the damages.
March 6,1962 Ash Wednesday Storm	The storm hit Virginia during spring tide, when sun and moon phase to produce a higher than normal tide. Storm moved north off the coast past Virginia Beach and then reversed its course moving again to the south and bringing with it higher tides and higher waves which battered the coast for several days. The storm's center was 500 miles off the Virginia Capes when water reached nine feet at Norfolk and seven feet on the coast. Huge waves toppled houses into the ocean and broke through Virginia Beach's concrete boardwalk and seawall. Houses on the Bay side also saw extensive tidal flooding and wave damage. An estimated $4 million in wind and flood damages occurred in Hampton. Winds up to 70 mph built 40-foot waves at sea. Flooding had a devastating effect on the Peninsula, including Grandview (Hampton) and Poquoson. Legendary storm caused over $200M (1962 dollars) damage from North Carolina to Long Island, New York.
January 27, 1998	Slow-moving nor'easter combined with high tides resulted in an extended period of gale force onshore winds, driving tides to 6.44 feet above MLLW at Sewells Point. Moderate coastal flooding was reported across the middle Peninsula and Northern Neck areas. The damage was estimated at $1.5 million.

Date	Description
March 13-14, 1993	The "Superstorm of March '93" was also known as "The Storm of the Century" for the eastern United States, due to its large area of impact, all the way from Florida and Alabama through New England. As the storm's center crossed Virginia, weather stations recorded their lowest pressure ever. Unlike most big winter storms that move up the coast, this storm took a more inland track across Richmond and the Chesapeake Bay. It brought rain and some high winds to Southeast Virginia and heavy snow and blizzard conditions over portions of the north and west. Eleven people died in Virginia from over-exertion and heart attacks shoveling snow or from exposure and hypothermia. Snow removal and clean-up costs were estimated at 16 million dollars statewide.
February 4,1998	Storm battered eastern Virginia for 3 days. Storm's slow movement resulted in an extended period of gale and storm force onshore winds, driving tides to 7.0 feet above MLLW at Sewell's Point in Norfolk. High tides resulted in severe coastal flooding throughout Hampton Roads and Eastern Shore. Damage was estimated at $75 million for Hampton Roads. $314,000 in costs incurred by York County government; approximately $75% direct damage, %20 debris-related, and 5% emergency response costs.
January 24-25, 2000	Storm spread heavy snow into Virginia. Several inches of snow was on the ground at daybreak on the 25th, with winds gusting at 25 to 45 mph, creating blizzard conditions in some areas. The region was at a standstill; airports and transit systems were shut down, schools were closed, Federal, state and county government offices were closed. Drifts of four to five feet were common. Snow mixed with sleet and freezing rain in some of the eastern counties of Virginia.

Source: VDEM 2004

4.1.6 Thunderstorms

Virginia averages 40 to 50 thunderstorm days per year (Sammler, 2005). Thunderstorms can occur any day of the year and at any time of the day, but are most common in the late afternoon and evening during the summer months, and in conjunction with frontal boundaries. Thunderstorms are generally beneficial because they provide needed rain for crops, plants, and reservoirs. About five percent of thunderstorms become severe and can produce tornados, large hail, damaging downburst winds, and heavy rains causing flash flooding. Thunderstorms can develop in less than 30 minutes, allowing little time for warning. The National Weather Service does not issue warnings for ordinary thunderstorms nor for lightning. The National Weather Service highlights the potential for thunderstorms in the daily forecasts and statements. Thunderstorms often create hazardous boating conditions for Peninsula mariners, who must be diligent in monitoring weather broadcasts for advance notice of late afternoon squalls or squall lines.

All thunderstorms produce lightning, which can be deadly. A bolt of lightning can strike 10 to 15 miles from the rain portion of a thunderstorm. The lightning bolt originates from the upper part of the thunderstorm cloud known as the anvil. A thunderstorm can grow up to 8 miles into the atmosphere where the strong winds aloft spread the top of the thunderstorm cloud out into an anvil. The anvil can spread many miles from the rain portion of the storm but it is still a part of that storm. Lightning bolts may come from the front, side or back of the storm, even striking after the rain and storm seem to have passed, or striking areas missed by rain.

Between 1959 and 2000, lightning killed 58 people in Virginia and injured at least 238 (Watson 2004). On the Peninsula, there have been at least 13 noteworthy lightning strikes since 1993, as shown in Table 4.1.6. The majority of the damage caused by lightning in the area was related to home strikes, and power line failures, but one person was reported injured and one person was reported killed. A typical 100-million volt lightning flash can heat the air to more than 40,000 degrees in an instant. This amazing amount of power can damage homes, down trees and power lines, and take lives. The best defense against this natural hazard is to recognize the danger and take shelter when appropriate.

Table 4.1.6- Recent Lightning Damage for Peninsula Communities*

Location	Date	Type	Death	Injury	Property Damage
Hampton	07/16/2003	Lightning	0	0	5K
Newport News	06/20/1996	Lightning	0	0	0
Newport News	06/19/2000	Lightning	0	0	100K
Newport News	06/06/2001	Lightning	0	0	0
Williamsburg	01/02/1996	Lightning	0	0	20K
Williamsburg	07/17/1995	Lightning	0	0	25K
Williamsburg	04/01/1993	Lightning	0	0	50K
Norfolk	09/04/1993	Lightning	0	1	500K
York County	06/26/2001	Lightning	0	0	0
Grafton	07/15/2000	Lightning	0	1	20K
Centerville	08/24/2000	Lightning	0	0	100K
Jamestown	08/30/2003	Lightning	1	0	0
James City County**	09/20/2005	Lightning	0	0	Roof damaged by fire, holes in roofs/walls

* Events shown were collected by NCDC and likely represent only a fraction of total lightning strikes.
***Daily Press*, 9/22/05

Figure 4.1.6 is based upon lightning strike data for the year 1989. The detector network established by the Electric Power Research Institute (EPRI) identified strikes, and the Virginia State Climatology Office compiled the map. Lightning data from EPRI are only available for a fee, and lightning data collected by NWS and NCDC do not detect all lightning strikes or occurrences. The figure below is only a one-year sample of the lightning climatology for the state; however, it depicts a distinct east-west geographic pattern of lightning strikes in 1989, with the Peninsula experiencing four to five flashes per square kilometer overall.

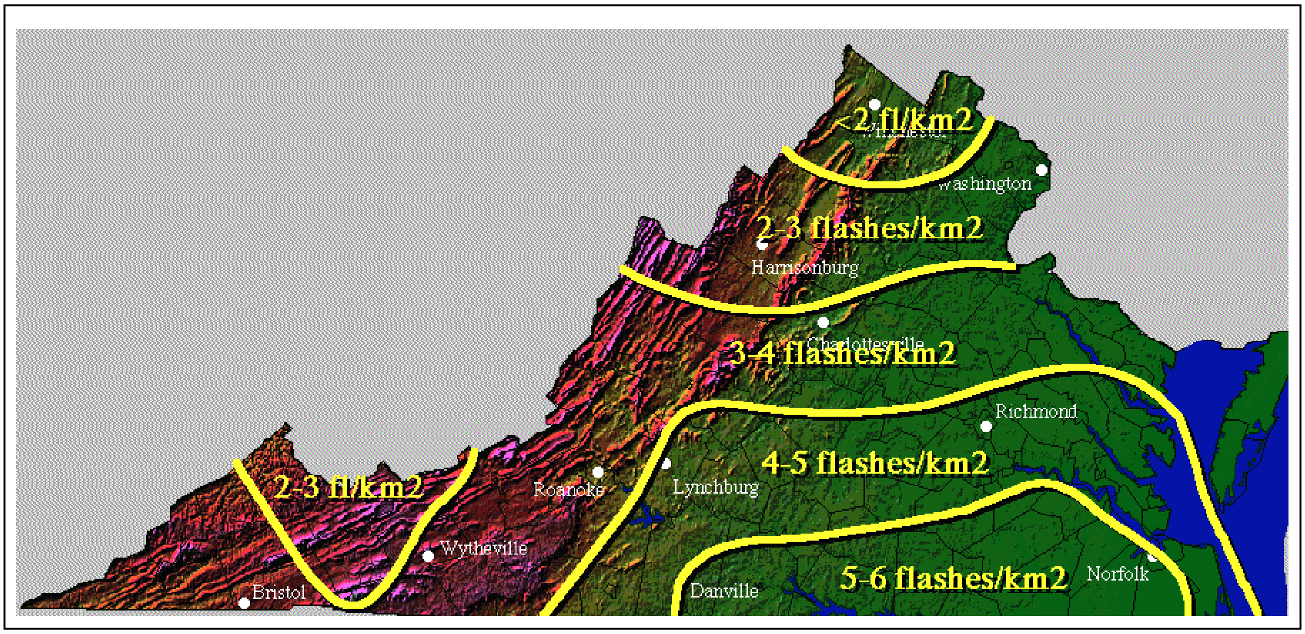
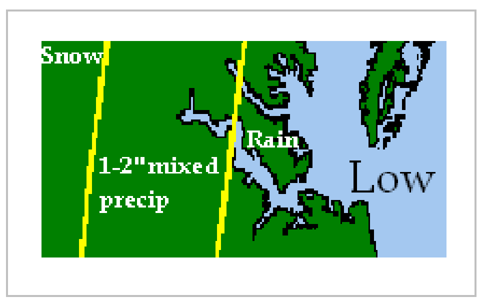


Figure 4.1.6 Virginia Lightning Strike Density Map for 1989 Only(State Climatology Office)

4.1.7 Winter Storms

Figure 4.1.7- Winter Storm Precipitation Pattern for the Peninsula



Source: VDEM 2004

Winter storms can refer to various types of precipitation including snow, freezing rain and ice. Sometimes winter storms are accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, severe drifting, and dangerous wind chill. Strong winds with these intense storms and cold fronts can knock down trees, utility poles, and power lines. Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the potentially extensive damage. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Heavy snow can immobilize a region and paralyze a community, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. The cost of snow removal, repairing damages, and loss of business can also have a significant economic impact on communities.

Although not all of Virginia's biggest winter storms are nor'easters, many of them are. At times, nor'easters have become so strong and produced such large amounts of blowing snow, that they have been termed "White Hurricanes."

Wind blowing counter clockwise around the storm center carries warm, moist air from the Gulf Stream up and over the cold inland air. The warm air rises and cools and snow begins. Heavy snow often falls in a narrow 50 mile wide swath about 150 miles northwest of the low pressure center (see Figure 4.1.7- Low pressure center or storm center is represented by "Low"). The Peninsula area is often affected by these storms.

It is also not uncommon for the Peninsula area to experience sleet, freezing rain, and ice storms. In fact, the Peninsula area has experienced 19 major winter weather events from 1993 – 2003. One such event occurred in December 1998. A major ice storm hit central and eastern Virginia, with ice accumulations of 0.5 – 1.0 inches that left dozens of power lines downed along with hundreds of tree limbs. Over 400,000 people in the area were left without power. The combination of automobile accidents, power line repair and clean-up cost the area over $20 million (NCDC 2004).

The recurrence of severe winter weather in the Peninsula area is certain. These winter storms often leave tree limbs and power lines down resulting in dangerous conditions. Other impacts can include collapsed roofs from fallen trees and heavy ice and snow loads as well as icy roads and sidewalks. Winter weather can have devastating effects on a community and occurs fairly frequently.

Table 4.1.7- Significant Winter Storm Events

Date	**Description**
January 18-19, 1857	See description in **Table 4.1.5b-Historic Virginia Nor'easters**
March 1-2, 1872	See description in **Table 4.1.5b-Historic Virginia Nor'easters**
November 17, 1873	Severe storm and gale brought high tides to tidewater area flooding wharves and the lower portion of Norfolk.
December 26-28, 1892	Norfolk set three local records for snow (Official Weather Records began in 1871). The greatest single storm amount with 18.6 inches; the most in 24 hours with 17.7 inches; and the maximum depth of snow on the ground with 18.6 inches. Normal snowfall at Norfolk is only 7.8 inches per year.
Winter of 1960-1961	Stormy pattern of previous winters continued with three more significant storms. The first was December 10-12, 1960 with heavy snow and high winds from Virginia to New York. In Virginia, snow fall ranged from 4 -13 inches in the north and west. Seven fatalities in Virginia. The next snowstorm struck on January 19-20 from North Carolina to New York. Virginia saw up to 12 inches. Two deaths were blamed on the storm in Virginia, due to overexertion and accidents. The third storm struck February 3-5 and hit like a blizzard with severe cold and gale force winds. Two to 13 inches of snow across Virginia, and four fatalities.
March 6, 1962 Ash Wednesday Storm	See description in **Table 4.1.5b-Historic Virginia Nor'easters**
Winter of 1980	On January 4 and 5, a heavy wet snow fell over eastern Virginia with as much as 18 inches reported at Williamsburg. A second storm hit on February 6 that dumped 6 inches in Williamsburg and as much as 20 inches at Virginia Beach. Over a foot of snow fell in Norfolk. Once again, arctic air had settled over Virginia and temperatures were in the teens. More than 1 foot of snow at Norfolk. The heavy snow combined with strong winds to create blizzard conditions. Norfolk's total for the season came to a

Date	Description
	record 41.9 inches making this the snowiest winter ever for eastern Virginia.
February 1989	This was a month of big swings in the weather for Southeast Virginia. Twice, Hampton Roads saw record high temperatures in the mid 70°s followed by a significant snowfall. The two storms that struck dumped a record 24.4 inches of snow at Norfolk. Over 14 inches occurred during one 24 hour period. It was the most snow to occur in one month in southeast Virginia in the last 100 years.
March 13-14, 1993	See description in **Table 4.1.5b-Historic Virginia Nor'easters**
January 6-8, 1996	Much of the eastern seaboard received 1 to 3 feet of snow. Wind gusts of over 50 mph were common and resulted in blizzard conditions for much of the east coast, including Virginia. Many areas of Virginia received over 20 inches of snow. Numerous accidents and flood related damages were reported in the area, along with 13 deaths in Virginia. Virginia, along with Ohio, Pennsylvania, Maryland, West Virginia and New York were declared Presidential Disaster Areas. All totaled the blizzard and resulting flooding killed and estimated 187 people and caused approximately $3 billion in damages along the eastern seaboard.
December 23, 1998	A prolonged period of freezing rain and some sleet resulted in ice accumulations of up to an inch. The heavy ice accumulations on trees and power lines caused widespread power outages. Many accidents occurred due to slippery road conditions, especially bridges and overpasses. Many secondary roads and parts of I-64 on the Peninsula were impassable due to fallen trees and tree limbs. Approximately 400,000 people were left without power in central and eastern Virginia and damages totaled more than $20 million. York County estimated at last $300,000 in damage costs incurred by the County; approximately 75% direct damage, 20% debris-related, and 5% emergency response costs.
February, 2004	On February 15 and 16, a winter storm hit the Tidewater area of Virginia dumping wind driven rain, freezing rain, and snow on a significant portion of Hampton Roads. Snow accumulation totals in some areas reached three to six inches and winds were reported at up to 30 mph. Sleet fell across much of the region causing roads to become icy and treacherous.

Source: NCDC

4.1.8 Extreme Heat

Extreme heat hazards result from high daily temperatures combined with high relative humidity. High relative humidity retards evaporation, robbing the body of its ability to cool itself. On average, about 175 Americans succumb to the taxing demands of heat every year (NOAA 2004).

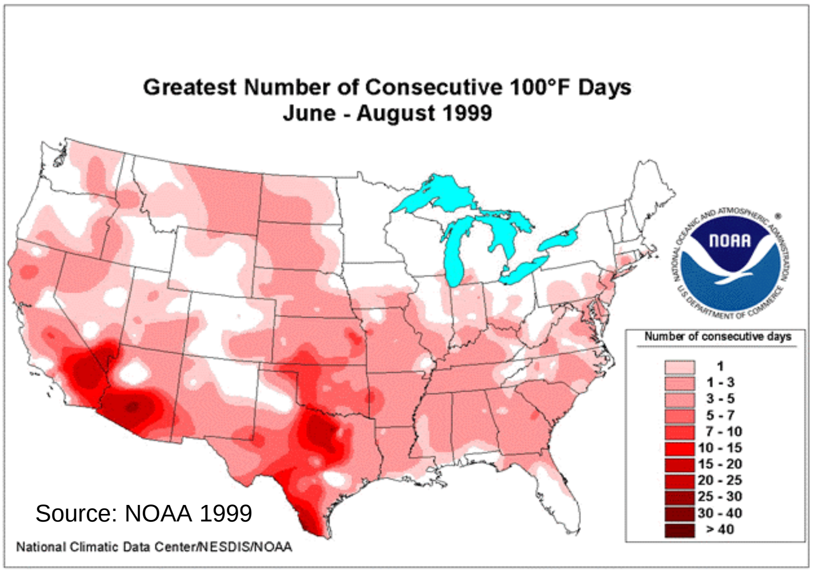
When heat gain exceeds the level the body can remove, body temperature begins to rise, and heat related illnesses and disorders may develop. The Heat Index (HI) is the temperature the body feels when heat and humidity are combined. Table 4.1.8 shows the HI that corresponds to the actual air temperature and relative humidity. This chart is based upon shady, light wind conditions. Exposure to direct sunlight can increase the HI by up to 15°F. (NOAA 2004).

Table 4.1.8 -Heat Index

Temperature (°F)	Relative Humidity					
	90%	80%	70%	60%	50%	40%
80	85	84	82	81	80	79
85	101	96	92	90	86	84
90	121	113	105	99	94	90
95		133	122	113	105	98
100			142	129	118	109
105				148	133	121
110						135

Source: NOAA 2004

Figure 4.1.8-Greatest Number of Consecutive 100°F Days



During the summer (June-August) of 1999, the United States experienced an intensifying drought and heat wave. The east coast was the area hardest hit by the drought, with record and near-record short-term precipitation deficits occurring on a local and regional scale resulting in agricultural losses and drought emergencies being declared in several states (NOAA 1999). Figure 4.1.8 shows the number of consecutive days of 100° temperatures.

The threat of extreme heat to the Peninsula communities is episodic and, although it cannot be controlled, threats to the population can be minimized by warnings and public awareness of the potential dangers that extreme heat presents.

4.1.9 Dam Failure

For the purposes of this plan, dam failure is addressed as a natural hazard resulting in a flooding condition. Dam failure can occur if hydrostatic pressure behind a dam exceeds design capacity or the crest of the dam is over-topped and rushing flood water scours the base of the dam. The hazard classification associated with dam failure is outlined below. Dams that meet regulatory criteria in Virginia are regulated under the Dam Safety Act established by the Virginia Soil and Water Conservation Board (VS&WCB). A dam may be exempt from the regulation if any of the following criteria apply:

- dam is less than 6 feet in height,
- dam has a capacity less than 50 acre-feet and is less than 25 feet in height,
- dam has a capacity of less than 15 acre-feet and is more than 25 feet in height,
- dam is used for primarily agricultural purposes and has a capacity less than 100 acre-feet (should use or ownership change, the dam may be subject to regulation),
- dam is owned or licensed by the Federal Government, or
- dam is operated for mining purposes under 45.1-222 or 45.1-225.1 of the *Code of Virginia*.

Dams are assigned a hazard classification based on the downstream loss anticipated in the event of dam failure. Hazard potential is not related to the structural integrity of the dam. The hazard potential classification speaks to the level of risk to life and economic loss the dam imposes on downstream properties and facilities. The classification scheme used by VS&WCB is as follows:

- **Class I** - dams which upon failure would cause probable loss of life or excessive economic loss,
- **Class II** - dams which upon failure could cause possible loss of life or appreciable economic loss,
- **Class III** - dams which upon failure would not likely lead to loss of life or significant economic loss, and
- **Class IV** - dams which upon failure would not likely lead to loss of life or economic loss.

The owner of each regulated Class I, II, or III dam is required to apply for an operational and maintenance certificate from VS&WCB. One of the requirements for obtaining the operational and maintenance certificate is the development of an emergency action plan. These plans are filed with the local emergency management official and VDEM. Table 4.1.9 provides the number of dams by classification for each community on the Peninsula. For further information regarding specific dams, please contact the local emergency management department.

Community	High Hazard		Low Hazard	
	Class I	Class II	Class III	Class IV
Hampton	0	0	0	0
Newport News	0	2	0	0
Williamsburg	0	1	1	1
James City County	0	0	1	0
York County	0	1	1	0

Table 4.1.9 - Number of Dams by Community and Hazard Classification

4.1.10 Wildfire

A wildfire is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures. Wildfires often start unnoticed and spread quickly, causing dense smoke that fills the area for miles around. Naturally occurring and non-native species of grasses, brush, and trees fuel wildfires. (FEMA, How-to Guide, 2-29) Generally, there are three major factors to consider in assessing the threat of wildfires to a community: topography, vegetation, and weather.

The type of land cover in an area affects a number of factors including ease of ignition, the intensity with which a fire burns, and the facilitation of wildfire advancement. Topographic variations, such as steep slopes, can lead to a greater chance of wildfire ignition. Generally, steep slopes are predisposed to convective pre-heating, which warms and dries the vegetative cover. Also, slopes that face south receive more direct sunlight than those facing north. Direct sunlight dries vegetative fuels, creating conditions that are more conducive to wildfire ignition. Population density has a causal relationship to wildfires because humans ignite an overwhelming majority of the wildfires in Virginia, intentionally or unintentionally. Travel corridors increase the probability of human presence, which increases the potential for wildfire ignition. Hence, areas close to roads have a higher ignition probability. Storms such as hurricanes and winter ice storms can topple trees, creating an enormous amount of debris, which can serve as wildfire fuel.

Recently, Hurricane Isabel brought down thousands of trees on the Peninsula. The resultant increase in potential fuel initiated a public awareness campaign by VDOF to educate the public regarding the increased hazard.

According to VDOF, approximately 30 percent of the Peninsula land area is a high fire risk zone, 38 percent is a moderate fire risk zone, and 32 percent is a low fire risk zone. See Appendix B for a map showing the boundaries of the wildfire hazard areas for all Peninsula communities. Table 4.1.10 summarizes the percentage of land area exposed to wildfire hazard for each Peninsula community. VDOF reports that there were approximately 32 wildfires on the Peninsula between 1995 and 2001, which resulted in approximately 70 acres of burned land (VDOF 2003).

Table 4.1.10 -Wildfire Hazard for Peninsula Communities

Community	Land Area (sq. mi.)	Fire Risk (sq. mi.)		
		High	Medium	Low
Hampton	51.8	3.5 (6.7%)	6.0 (11.6%)	42.3 (81.7%)
Newport News	176.9	16.1 (9.1%)	36.8 (20.8%)	124.0 (70.1%)
Williamsburg	8.5	0.8 (9.0%)	3.1 (36.1%)	4.7 (54.9%)
James City County	143.0	47.6 (33.3%)	18.0 (12.6%)	77.4 (54.1%)
York County	106.0	53.0 (50.0%)	42.3 (39.9%)	10.7 (10.1%)
Total	486.2	147.8 (30.4%)	183.8 (37.8%)	154.1 (31.7%)

4.1.11 Drought

All of the Peninsula communities are susceptible to droughts, which are defined by a combination of intensity and duration. In a one-year time frame, droughts are considered large when the 12-month rainfall averages about 60 percent of normal. On a multi-year time scale, 75 percent of normal rainfall indicates a serious problem. High summer temperatures can exacerbate the severity of a drought. Normal high summer temperatures in central and eastern Virginia can reach the 90 degree mark and higher. Most of the soil is relatively wet, and a great deal of the sun's energy goes toward evaporation of the ground moisture. However, when drought conditions eliminate soil moisture, the sun's energy goes toward heating the ground surface and temperatures reach into the low 100's – further drying the soil. This can have a devastating effect on crops, stream levels and water reserves. A short-term precipitation deficit of six summer weeks can often ruin crops. Droughts lasting a year, which occur in the Mid-Atlantic when the region receives 60 percent of the typical 40 inches of rain, begin to draw down water wells and livestock ponds and decrease stream flows and water reserves.

VDEM rates Virginia's drought risk as "Significant," with Virginia communities experiencing approximately 20 years of severe drought in the last century. These droughts have caused millions of dollars of damage. There are two primary drought monitoring tools currently in use in the United States. The Palmer Drought Index (PDI) has been used for U.S. drought monitoring for the last 30 years. It is based on a water budget model that incorporates the balance between water supply (i.e., precipitation), soil moisture, runoff, and water demand (computed from estimates for evaporation and transpiration). The U.S. Drought Monitor is a blend of science and subjectivity, resulting in a drought severity classification table based on ranges for primary indicators for each dryness level. Because the ranges of the various indicators often do not coincide, the final drought category tends to be based on what the majority of the indicators show. The analysts producing the map also weight the indices according to how well they perform in various parts of the country and at different times of the year. The PDI is one of many indicators used to develop the U.S. Drought Monitor. Other indicators include: soil moisture, weekly streamflow, standardized precipitation, and a satellite vegetation health index. Table 4.1.11 provides a description of possible impacts for the drought severity categories indicated by the U.S. Drought Monitor.

Table 4.1.11 -U.S. Drought Monitor, Drought Severity Classification

Category	Description	Possible Impacts
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.
D1	Moderate Drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested
D2	Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed
D3	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells, creating water emergencies

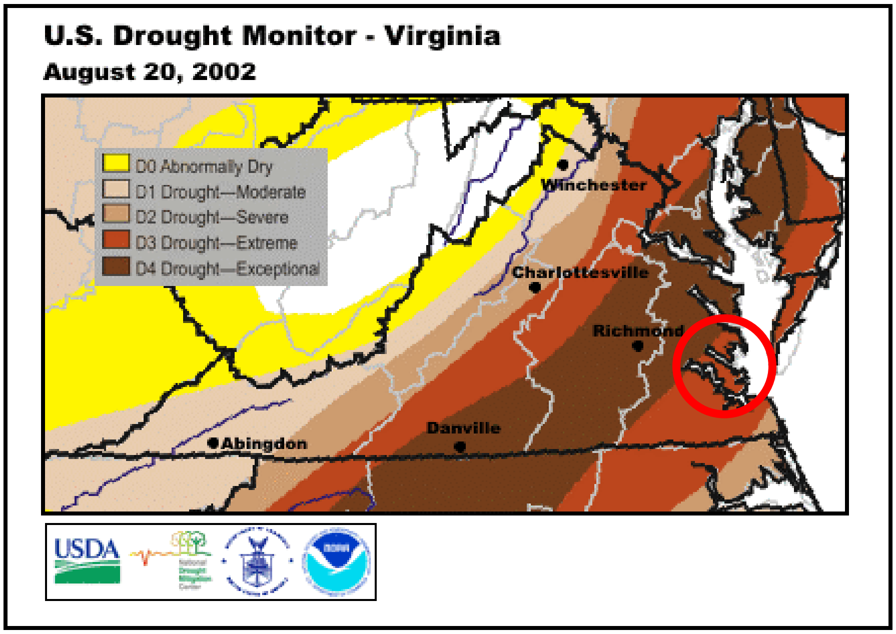
Since the early 1900s, there have been six major droughts that have affected the communities on the Peninsula. The drought of 1930-32 was one of the most severe droughts recorded in the region. The droughts of 1938-42 and 1962-71 were less severe; however, the 1962-71 drought had an extreme duration. The droughts of 1980-82 and 1998-99 were the least severe for the state; however, the drought of 1998-99 hit the communities of the Peninsula region particularly hard. The drought of 2000-2002 was felt statewide, and is considered the most significant since the 1930-32 event. (Sammler, 2005)

The drought of 1930-32 had a tremendous effect on Virginia. Numerous rivers completely dried up, crops were totally destroyed, drinking water was difficult to find, forest fires burned approximately 300,000 acres of land (over 30 times the current annual average) and average summer temperatures were in the low 100's. After adjusting for inflation, the estimated losses for this drought were $1 billion. If the same drought were to occur in Virginia today, the devastation would be much greater due to an increased population and demand for water resources.

The drought of 1998-99 had a particularly hard impact on the Peninsula. The region received some of the lowest rainfall totals in over 120 years. This led to decimated crops and depletion of water and feed reserves, as well as a number of brush fires. Many stream-gauging stations reported streamflow at or below 10 percent of the normal flow. On December 1, 1998, the

Governor declared a state of emergency and requested federal aid. Losses in the region grew to nearly $190 million. During August of 1999, NOAA ranked the Peninsula area in a moderate to severe drought.

Figure 4.1.11- U.S. Drought Monitor, August 20, 2002



Following shortly on the heels of the 1998-99 drought, the designated drought of 2000-2002 reached its height in late summer, early fall of 2002. The Virginia Drought Monitoring Task Force, a consortium of interested state and Federal agencies, provided Drought Status Reports on a monthly basis between June and November 2002. Conditions deteriorated quickly in the first two weeks of August 2002, and the U.S. Drought Monitor indicated an "Extreme Drought" for the Peninsula (see Figure 4.1.11) by August 20th. Drought indicators were numerous and severe: record minimum flows on the James and York Rivers, continually declining groundwater levels, declining reservoir levels, short or very short topsoil moisture conditions across 82 percent of the Commonwealth, numerous ozone advisories, and higher than normal wildfire activity. For the Tidewater area, normal one-year precipitation for the period September 2001 to August 2002 was 41.17 inches. By August 20, 2002, the one-year precipitation was only 29.35 inches, a 71-percent departure from normal. Newport News Waterworks customers were under voluntary conservation measures beginning July 25, with the reservoir at 71 percent capacity. James City Service Authority Central System instituted voluntary measures, as well. The Waller Mill Reservoir serving Williamsburg dropped 27 inches below the spillway, and voluntary conservation measures went into effect on March 20, 2002. Williamsburg was purchasing water from Newport News Waterworks in July. By November 2002, much of the Peninsula area had returned to normal conditions due to rainfall after September 1st.

4.1.12 Earthquakes

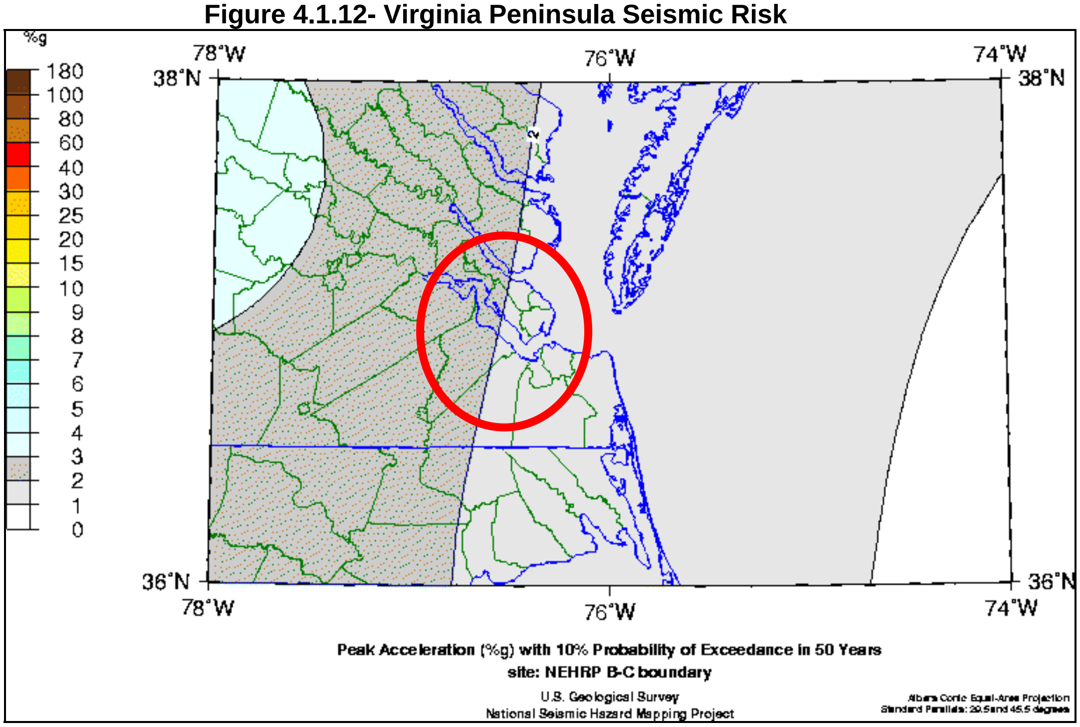
The earth's outer surface is broken into pieces called tectonic plates, which move away from, towards or past each other. Because the continents are part of these plates, they also move. An earthquake occurs when the stresses caused by plate movements are released. The abrupt release of stored energy in the rocks beneath the earth's surface results in a sudden motion or trembling of the earth. The epicenter is the point on the Earth's surface directly above the source of the earthquake.

Smaller earthquakes occur much more frequently than large earthquakes. These smaller earthquakes generally cause little or no damage. However, very large earthquakes can cause tremendous damage and are often followed by a series of smaller aftershocks lasting for weeks after the event. This phenomenon, referred to as 'minor faulting,' occurs during an adjustment period that may last for several months.

Virginia and the eastern side of the North American continent are in the middle of a tectonic plate. The states east of the Mississippi River have fewer earthquakes than the western portion of the country. Quakes occurring in the west are typically stronger, but eastern earthquakes can cause more damage away from their origin because the underlying bedrock is well-connected (like a concrete slab). This geology allows eastern earthquakes to travel farther than in the west, where the underlying topography is so disconnected (like a brick patio) that the energy of a quake is dissipated closer to the epicenter.

According to the Virginia Department of Mines, Minerals and Energy, Virginia has a moderate earthquake risk (similar to most states on the eastern seaboard). This risk assessment is further supported by the USGS. The USGS rates areas of the United States for their susceptibility to earthquakes based on a two or ten percent probability of a given peak force, being exceeded in a 50 year period. Based on the map shown in Figure 4.1.12, the Virginia Peninsula lies in an area of moderate seismic risk, with a 10% chance in the next 50 years that a peak acceleration of one to three percent g will be equaled or exceeded.

Figure 4.1.12- Virginia Peninsula Seismic Risk



The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The magnitude of an earthquake is determined from the logarithm of the amplitude of waves recorded by seismographs. Adjustments are included for the variation in the distance between the various seismographs and the epicenter of the earthquakes. On the Richter Scale, magnitude is expressed in whole numbers and decimal fractions. For example, a magnitude 5.3 might be computed for a moderate earthquake, and a strong earthquake might be rated as magnitude 6.3. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude; as an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

The effect of an earthquake on the Earth's surface is called the intensity. The intensity scale consists of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys, and finally, total destruction. Although numerous *intensity scales* have been developed over the last several hundred years to evaluate the effects of earthquakes, the one currently used in the United States is the Modified Mercalli Intensity (MM) Scale. It was developed in 1931 by the American seismologists Harry Wood and Frank Neumann. This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It does not have a mathematical basis; instead it is an arbitrary ranking based on observed effects.
The Modified Mercalli Intensity value assigned to a specific site after an earthquake has a more meaningful measure of severity to the nonscientist than the magnitude because intensity refers to the effects actually experienced at a particular place.

The lower numbers of the intensity scale deal with the manner in which people feel the earthquake. The higher numbers of the scale are based on observed structural damage. Structural engineers usually contribute information for assigning intensity values of VIII or above. The following is an abbreviated description of the 12 levels of Modified Mercalli intensity:

Table 4.1.12a- Modified Mercalli Intensity Scale

Level	Description
I	Not felt except by a very few under especially favorable conditions.
II	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Historically significant Virginia earthquakes were first recorded in 1774. Virginia has had over 160 earthquakes since 1977, of which 16 percent were felt. This equates to an average of one earthquake occurring every month with two felt each year (VTSO, 2005). On February 21, 1774, a strong earthquake was felt over much of Virginia and southward into North Carolina. Many houses were moved considerably off their foundations at Petersburg and Blandford (intensity MM VII). The shock was described as "severe" at Richmond and "small" at Fredericksburg. However, it "terrified the inhabitants greatly." The total felt area covered about 57,900 square miles.

The three great earthquakes near New Madrid, Missouri, in 1811 - 1812 (December 11th, January 23rd, and February 7th) were felt strongly in Virginia. Reports from Norfolk and Richmond newspapers describe the effects in detail.

An earthquake, apparently centered in southwestern Virginia, on March 9, 1828, was reported felt over an area of about 218,090 square miles, from Pennsylvania to South Carolina and the Atlantic Coastal Plain to Ohio. Very few accounts of the shock were available from places in Virginia; it was reported that doors and windows rattled (MM V). President John Quincy Adams felt this tremor in Washington D.C., and provided a graphic account in his diary. He compared the sensation to the heaving of a ship at sea.

The August 27, 1833, earthquake covered a broad felt area from Norfolk to Lexington and from Baltimore, Maryland, to Raleigh, North Carolina - about 52,110 square miles. Two miners were killed in the panic the shock caused at Brown's Coal Pits, near Dover Mills, about 18 miles from Richmond. At Charlottesville, Fredericksburg, Lynchburg, and Norfold, windows rattled violently, loose objects shook, and walls of buildings were visibly agitated (MM V).

Another moderately strong widely felt shock occurred on April 29, 1852. At Buckingham and Wytheville, chimneys were damaged (MM VI). The felt area extended to Washington D.C., Baltimore, Maryland, and Philadelphia, Pennsylvania, and also included many points in North Carolina - approximately 162,120 square miles. This pattern was repeated on August 31, 1861. The epicenter was probably in extreme southwestern Virginia or western North Carolina. At Wilkesboro, North Carolina, bricks were shaken from chimneys (MM VI). The lack of Virginia reports may perhaps be ascribed to the fact that the Civil War was under way and there was heavy fighting in Virginia at the time. This shock affected about 299,150 square miles and was felt along the Atlantic coast from Washington, D.C., to Charleston, South Carolina, and westward to Cincinnati, Louisville, and Gallatin, Tennessee, and southwestward to Columbus, Georgia.

A series of shocks in quick succession disturbed the eastern two-thirds of Virginia and a portion of North Carolina on December 22, 1875. At Manakin, many chimneys were broken and shingles on one store were shaken off (MM VII). Damage to chimneys was reported from other places in Goochland and Powhatan Counties. At Richmond, the shock, which was accompanied by a rumbling noise, was severe and lasted from 20 to 30 seconds; plaster fell and several panes of window glass broke. There was general alarm in all parts of the city; many people ran out of their houses in fright. The total felt area was about 50,180 square miles.

The famous 1886 earthquake in Charleston, South Carolina was felt on the Virginia Peninsula, and the Hampton Roads region. Plaster damage in Williamsburg, as well as broken chimneys in nearby Norfolk were typical of impacts throughout the Commonwealth. In Norfolk, light framework was thrown down, large warehouses were damaged, and the earthquake caused panic in the Opera House. The event led to reports of nausea among many residents of Norfolk, and had an estimated magnitude of 6.6 to 6.9, and was felt as far north as Canada and as far south as Cuba. Residents of Missouri also felt the earthquake.

The largest earthquake to originate in Virginia is historic times occurred on May 31, 1897. The epicenter was in Giles County, where on May 3rd, an earlier tremor at Pulaski, Radford, and Roanoke had caused damage (MM VI). Loud rumblings were heard in the epicentral region at various times between May 3rd and 31st. The shock on the latter date was felt from Georgia to Pennsylvania and from the Atlantic Coast westward to Indiana and Kentucky, an area covering about 279,850 square miles. It was especially strong at Pearisburg, where the walls of old brick houses were cracked and bricks were thrown from chimney tops. Springs were muddied and a few earth fissures appeared (MM VIII). Chimneys were shaken down at Bedford City, Houston, Pulaski, Radford, and Roanoke. Chimneys were also broken at Raleigh, North Carolina, Bristol and Knoxville, Tennessee, and Bluefied, West Virginia. Minor tremors continued in the epicentral region from time to time until June 6th; other disturbances felt on June 28th, September 3rd, and October 21st were probably aftershocks. On February 5, 1898, the residents of Pulaski reported additional chimney damage (MM VI). In Newport News, there were reports that the earthquake "frightened a great many people." The shake was more perceptible "near the edge of the water, where it caused the piers and buildings to rock," but no damage was reported. In Williamsburg, the earthquake was felt by "nearly everybody in town.". (VTSO 2005)

An earthquake on February 11, 1907, caused minor damage at Arvonia, Ashby, and Buckingham. At Arvonia, many people became terrified and ran from their houses (MM VI); although no damage was reported from Columbia, many ran from their homes. The felt area was small, approximately 5600 square miles. Other shocks of lesser intensity occurred in the same area on August 23, 1908, and May 8, 1910.

The Shenandoah Valley region was strongly shaken by an earthquake on April 9, 1918. It was called the "most severe earthquake ever experienced" at Luray. Although little damage resulted, people in many places over the northern valley region were greatly alarmed and rushed from their houses (MM VI). Broken windows were reported at Washington, D.C. President Wilson and his family at the White House noticed the tremor; the President's secretary called a newspaper office to learn the cause of the terrifying noise. The felt area extended over 60,000 square miles, including parts of Maryland, Pennsylvania, and West Virginia. Another shock on September 5, 1919, was felt in the same general region, although the total affected area was much smaller. It was strongest in the Blue Ridge Mountains south of Front Royal. At Arco, plaster fell and some chimneys were damaged (MM VI). Springs and streams were muddied in the epicentral area.

On December 26, 1929, a moderate shock at Charlottesville shook bricks from a few chimneys (MM VI). It was reported felt in various parts of Albemarle County. A number of newspaper accounts gave the date of this earthquake as December 25th. Giles County was strongly shaken again on April 23, 1959. At Eggleston and Pembroke, several chimneys were damaged, plaster cracked, and pictures fell from walls (MM VI). A wide area (about 2,900 square miles) of southwestern Virginia felt the tremor; a few places in West Virginia also reported the shock. (USGS 2005)

The April 23, 1959 earthquake was strongest in Giles County, at Eggleston and Pembroke. Residents there reported several damaged chimneys and articles shaken from shelves and walls. One chimney toppled at the Norfolk and Western Station in Eggleston. The quake was also felt in West Virginia.

An earthquake in southwest Virginia on November 11, 1975 broke windows in the Blacksburg area of Montgomery County, and plaster cracked at Poplar Hill. The quake was also felt in Pulaski County. Another southwest Virginia event on September 13, 1976 was observed in many towns in North Carolina and Virginia and in a few towns in South Carolina and West Virginia. Bricks fell from chimneys and pictures fell from walls in Surry County at Mount Airy, N.C. At the nearby town of Toast, N.C., cracks formed in masonry and plaster. (VTSO 2005)

The *Daily Press* and *Virginian-Pilot* newspapers reported a minor, but relatively rare, earthquake with its epicenter on the Peninsula August 3, 1995. According to the *Virginian-Pilot*, the quake measured 2.6 on the Richter scale. The Virginia Tech Seismological Observatory detected the quake with instrumentation in Goochland County west of Richmond, and in Blacksburg. The quake was centered under the York River near York River State Park. According to the *Daily Press*, people at Camp Peary reported feeling the quake.

The December 9, 2003 Powhatan County earthquake was a complex event consisting of two sub-events occurring 12 seconds apart. Slight damage (MM VI) was reported at Bremo Bluff and Kents Store. The event was felt (MM V) at Columbia, Fork Union, Goochland, Oilville, Rockville and Sandy Hook; (MM IV) at Appomattox, Amelia Court House, Amherst, Blackstone, Bumpass, Charlottesville, Chester, Chesterfield, Colonial Heights, Cumberland, Dillwyn, Farmville, Glen Allen, Lawrenceville, Louisa, Manakin Sabot, Mechanicsville, Midlothian, Mineral, Palmyra, Petersburg, Powhatan, Richmond, Scottsville and Spotsylvania; (MM III) at Alexandria, Fairfax, Falls Church, Fredericksburg, Lexington, Lynchburg, McLean, Roanoke, Staunton and Vienna. It was also felt (MM III) at Bethesda, Rockville and Silver Spring, Maryland and at Rocky Mount and Winston Salem, North Carolina. Felt (MM II) at Chapel Hill, Greensboro and Raleigh, North Carolina and at Washington, DC. Felt in much of Maryland and Virginia and in north-central North Carolina and a few areas of Delaware, New Jersey, New York, Pennsylvania and West Virginia.
A summary of collected data for historical, significant and recent earthquakes in the region is provided in Table 4.1.12. Because the data was gathered from a variety of sources, all indicators are not available for each event.

Table 4.1.12b -Summary of Virginia Earthquake Data

Year	Location	Focus Depth (km)	Deaths	Damage ($)	Richter Scale Magnitude	MMI	Felt Area (square miles)
1774	Near Petersburg	not available	0	0	4.5	6	58,000
1828	Location not recorded	not available	0	0	4.6	5	
1833	Central Virginia	not available	0	0	4.5	5	52,000
1852	Near Wytheville	not available	0	0	4.8	6	174,500
1852	Central Virginia	not available	0	0	4.3	6	32,000
1853	Location not recorded	not available	0	0	4.6	5	
1875	Central Virginia	not available	0	0	4.8	7	50,000
1885	Nelson County	not available				6	25,000
1897	Giles County	not available	0	0	5.6	8	280,000
1897	Southwest Virginia	not available	0	0	4.3	6	89,500
1898	Pulaski	not available	0	0	4.4	6	34,000
1898	Location not recorded	not available	0	0	4.5	5	
1899	Location not recorded	not available	0	0	4.5	5	
1907	Near Arvonia	not available	0	0	4	6	5,600
1918	Luray	not available	0	0	4.6	6	65,000
1919	Near Front Royal	not available	0	0	0	6	
1929	Charlottesville	not available	0	0	3.7	6	1,000
1954	Lee County	not available				6	
1959	Giles County	1	0	0	3.9	6	2,050
1969	Rich Creek					6	100,000
1975	Southwest Virginia	1	0	0	3.2	6	
1976	Southwest Virginia	9	0	0	3.3	6	9,000
1991	Virginia	18	0	0	0	5	
1995	York River	not available	0	0	2.6	not available	
1997	Near Culpeper	not available	0	0	2.5	not available	
1997	Near Manassas	not available	0	0	2.5	not available	
1997	Near Galax	not available	0	0	2.2	not available	
1998	Near Dillwyn	not available	0	0	3.8	not available	
2001	Shadwell, east of Charlottesville	not available	0	0	3.2	not available	
2003	30 miles SE of Charlottesville	not available	0	0	3.9	not available	
2003	Near Ashland	not available	0	0	2.6	not available	
2003	Powhatan County	< 5	0	0	4.5	6	~22,500

Sources: USGS, National Atlas, 30 June 1999
Daily Press and *Virginian-Pilot*, August 4, 1995
USGS Significant Earthquakes of the World for 2003 web site
Washington Post, December 10, 2003

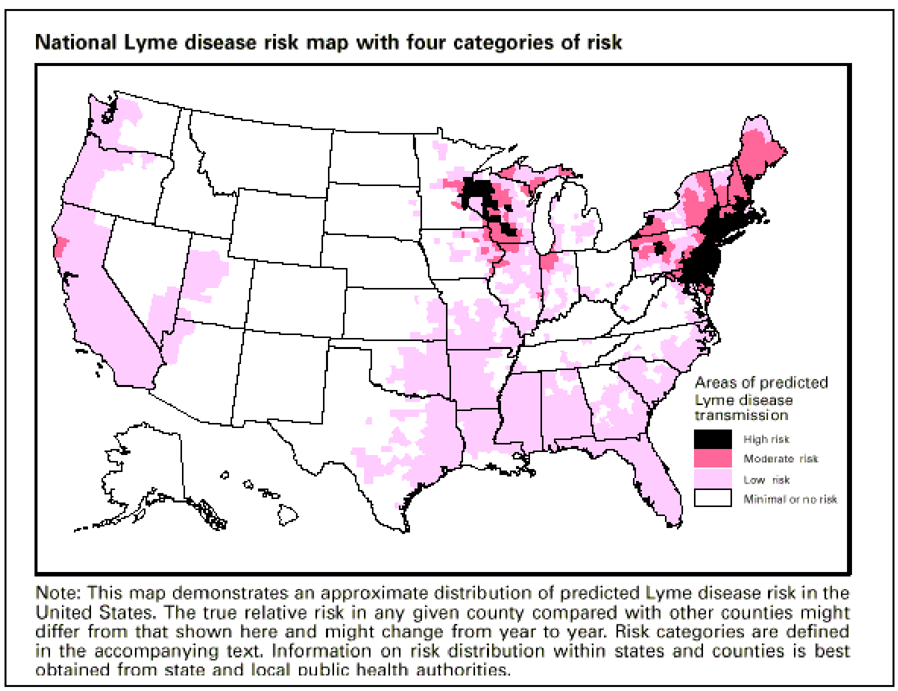
4.1.13 Biological Hazards/Epidemics

Biological hazards originate from naturally occurring substances such as bacteria, fungi, molds and viruses. In many cases these hazards are not visible, yet they can cause serious health effects to humans, plants and animals. West Nile Virus, Lyme disease, and bacterial epidemics have all been documented in the Peninsula region within the last ten years.

West Nile Virus (WNV) was first reported in the United States in 1999. Since then, almost 10,000 people have fallen ill across the country. WNV is transmitted to humans through mosquito bites and usually causes little reaction. However, a small percentage of those infected develop mild symptoms that include fever, headache, body aches, skin rash, and swollen lymph glands. Less than one percent of infected people develop a more severe illness that can include meningitis (inflammation of one of the membranes covering the brain and spinal cord) or encephalitis. The Peninsula communities have taken a proactive stance against WNV by attempting to eliminate mosquito populations and breeding grounds, especially those created by trees felled during Hurricane Isabel. Some of the techniques used are low volume spraying, draining areas of standing water, and introducing mosquito-eating fish. Additionally, York County coordinates with the Virginia Department of Transportation (VDOT) to maintain easements and right-of-ways that contain standing water. According to the Virginia Department of Health, there were 101 positive WNV cases for animals (birds, horses, and mammals) in the Peninsula region from 2000 to 2003. There was one probable case of human WNV in the City of Newport News in 2003.

Lyme disease is a bacterial infection that can afflict humans and animals. It is most commonly transmitted to humans bitten by deer ticks. If Lyme disease goes untreated, some patients may develop arthritis, including intermittent episodes of swelling and pain in the large joints; neurological abnormalities, such as meningitis, facial palsy, motor and sensory nerve inflammation and encephalitis; and cardiac problems, such as an enlarged heart and inflammation of the heart

Figure 4.1.13 -National Lyme Disease Risk Map



Source: CDC 2004

tissue. The Peninsula region is an area of low risk for Lyme disease transmission, according to the Centers for Disease Control and Prevention (CDC 2004); see Figure 4.1.13. In 2002, the CDC reported 259 cases of Lyme disease (out of 23,763 nationwide) in Virginia.

Bacteria and viruses can cause water contamination and have disastrous effects on the animals living within polluted waterways. In some instances, pollution from storm flooding and combined sewer overflow may produce high levels of fecal coliform bacteria and viruses in rivers and drinking water. The Poquoson River, Chisman Creek, Patrick's Creek, Lambs Creek, Roberts Creek, and Lyons Creek are all listed as bacteria impaired water body segments on the VDEQ's 2003-2004 Total Maximum Daily Load schedule.

4.1.14 Landslide

Landslides constitute a major geologic hazard because they are widespread, occurring in all 50 states. Landslides cause $2 billion in damage annually and more than 25 fatalities on average each year (USGS 2003). Landslides can and do occur in conjunction with other natural hazards, such as heavy rain events and earthquakes or human activities like excavations. Landslides can be broken down into falls, flows, or slides based on the type of earth movement (USGS 2003).

Most of the Peninsula area is classified as low landslide risk on the Landslide Incidence and Susceptibility Map (USGS 2001). There are however small areas that are listed as Moderate. These areas occur in Hampton, James City County, Newport News, and York County (see Appendix B for Landslide Hazard Map). The data used to generate these maps (USGS 2001) was highly generalized; therefore, further investigation at the local level is recommended.

4.1.15 Expansive Soils

Soils with a sufficient content of certain types of clay experience a change in volume during a transition from dry to wet conditions. These soils are called expansive soils, or "shrink-swell" soils. Hazards associated with expansive soils arise from the change in volume experienced. This physical factor can result in slope instability and cause damage to building foundations. Each community within the Peninsula region addresses the issue of expansive clay in their respective comprehensive plans, and addresses soil conservation based on state standards set forth in the Virginia Erosion and Sediment Control Law and Regulations.

4.1.16 Tsunami

"Tsunami" is a Japanese word meaning "harbor wave" and is a water wave or a series of waves generated by an impulsive vertical displacement of the surface of the ocean or other body of water (NOAA 2005b). A tsunami can occur when a series of ocean waves are generated by a sudden displacement in the sea floor, landslides, or volcanic activity. In the ocean, the tsunami wave may only be a few inches high. The wave may come gently ashore or may increase in height to become a fast moving wall of turbulent water several meters high (NOAA 2005a).

Tsunamis, commonly called seismic sea waves-or incorrectly, tidal waves, have been responsible for at least 470 fatalities and several hundred million dollars in property damage in the United States and its territories. These events are somewhat rare and major tsunamis occur in the Pacific Ocean region only about once per decade (NOAA 2005b).

Tsunamis have occurred only rarely along the Atlantic Coast. The National Geophysical Data Center (NGDC) administered by NOAA maintains a database of worldwide tsunami events recorded since 2000 B.C. According to the NGDC database, there have been 39 events along the North American Atlantic coast that have generated tsunamis.

According to the most recent data, in order for a tsunami to impact the East Coast, an earthquake with a magnitude of 9.0 or greater would need to take place north of Puerto Rico. Although the chances of a tsunami impacting the coast are minute, it could potentially produce waves from four to six feet along the coast. (Sammler, 2005) Klaus Jacob of the Lamont-Doherty Earth Observatory in New York estimated that a tsunami "has a lower than 1 in 1000 chance of occurring in eastern North America in any given year" (Boston Globe, 2004).

Because of the irregularity of the Peninsula’s coastline, a tsunami’s effects would vary geographically. Along the Chesapeake Bay coastline, the effect would be similar to that of a nor’easter at high tide, with shoreline erosion and damage to docks and piers. Other effects would be beach erosion, dune and seawall overwash, coastal flooding and damage to low-lying properties. Along inner creeks and rivers that narrow in width inland, flooding would be amplified as the wave is confined to a more narrow space (MGS, 2005).

Although earthquake-driven tsunamis pose some risk to the Peninsula, another source of tsunami action exists closer to home. Driscoll and others (2000) documented a large submarine landslide off the coast of Virginia. The Albemarle-Currituck Slide occurred approximately 18,000 years ago, involving over 33 cubic miles of material which slid seaward from the edge of the continental shelf, most likely causing a tsunami. Cracks in the continental shelf exist in this area, which may indicate slope failure and potential for another submarine landslide and subsequent tsunami of several meters in height. Impacts from a tsunami of this height would be similar to storm surge from a Category 3 or 4 hurricane.

4.1.17 Sea Level Rise

While not specifically called out in discussions with the PHMPC when identifying the natural hazards that the Peninsula faces, sea level rise can be expected to have an impact, over time, in the region. Because much of the coastal land area in the region lies at elevations at or below 7 feet MSL, any increase in the mean low water level of the Chesapeake Bay and surrounding tidal rivers and estuaries has a direct impact on coastal lands. These impacts may include the potential for increased erosion, loss of coastal zone lands, including wetlands, and a potential for increased damages from coastal storms.

Research conducted by NOAA indicates that, during the period 1854 to 1999, sea level in the Chesapeake Bay region has risen from 1.30 to 1.45 feet (NOAA 2001). The rising sea level trend is attributed to two primary sources: a slow, gradual rise in ocean levels, and land subsidence caused primarily by natural geologic processes and, in localized areas, by groundwater withdrawal (Boesch *et al*, undated). By weighing the impact of future potential sea level rise, as well as the future storm impacts when making future land use decisions, the region has the opportunity to take a more proactive approach to regulatory protections. Sea level rise can be expected to continue through the foreseeable future, which warrants continued vigilance at the local level; however, reducing the rate of sea level rise is outside the realm of local control (Boesch *et al*, undated).

Protecting tidal structures and wetlands may mean more active management at the local level, including techniques to ensure adequate elevation of structures and adequate erosion and sediment control measures. FEMA estimates that at the rate of sea level rise experienced on average around the coastal United States, roughly 12 inches per century, the number of households subject to flooding would increase from about 2.7 million now to almost 6 million by 2100 as a result of the combination of sea level rise and projected coastal population growth (Office of Technology Assessment, 1993). Over time, sea level may also change the physical characteristics of the region's floodplains. One way in which Peninsula communities may wish to address this gradual threat is by examining floodplain management ordinances to consider the inclusion of a one-foot or more freeboard requirement for new development or substantial improvements in the floodplain.

Sea level rise further exacerbates coastal erosion by causing the boundary between land and water to recede and move inland.

4.1.18 Critical vs. Non-critical Hazards

Based on readily available data, local knowledge, and observations, the PHMPC performed a two-stage evaluation of above-mentioned hazards utilizing the Natural Hazard Ranking Sheet (Appendix D). First, they grouped the hazards into two categories: critical and non-critical hazards (Table 4.1.17).

> **Critical hazards:** those hazards in which historical data exist to document impacts that have resulted in significant losses to the Peninsula region and its citizens. Critical hazards are those natural hazards that occur with little or no warning and have the possibility to create such widespread destruction that resources from outside the jurisdiction would be required to respond or recover.
>
> **Non-critical hazards:** those hazards that have occurred very infrequently or have not occurred at all in the historical data. They are not considered a widespread threat resulting in significant losses of property or life. Non-critical hazards also include hazards that occur frequently (on average every year) and those that the jurisdiction is equipped to mitigate.

Secondly, the PHMPC, in conjunction with the consulting team, ranked each critical hazard based on the threat posed to its citizens (Table 4.1.17). Hazards that ranked critical with a medium to high hazard level were then investigated further and a vulnerability analysis was performed for affected communities.

Table 4.1.18 -Hazard Identification Results

Hazard type	Non-Critical/Critical	Hazard Level
Flooding	Critical	High
Hurricanes	Critical	High/Medium
Tornados	Critical	Medium
Wildfire	Critical	Medium
Nor'easters	Critical	Medium/Low
Winter storms	Critical	Medium/Low
Drought	Non-Critical	Low
Earthquakes	Non-Critical	Low
Biological Hazards/Epidemics	Non-Critical	Low
Thunderstorms	Non-Critical	Low
Dam Failure	Non-Critical	Low
Extreme Heat	Non-Critical	Low
Expansive Soils	Non-Critical	Low
Landslides	Non-Critical	Low
Sea Level Rise	Non-Critical	Low
Tsunamis	Non-Critical	Low

5.0 Community Specific Profiles

The previous section addressed general hazard information as it applies to the entire Peninsula region. The following sub-sections address critical hazards that have a significant recurrence interval that is measurable, and a known hazard history. These sections describe the history of occurrence, vulnerability assessment for a particular hazard, and the community capability analysis for addressing these natural hazards.

A vulnerability assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from hazard events. The assessment provides the foundation for the rest of the mitigation planning process by defining and quantifying various problems. The assessment process focuses attention on vulnerable areas with the greatest needs by evaluating populations and facilities that are most vulnerable to community specific hazards and to what extent injuries and damages may occur (FEMA, 2001). The risk assessment process allows a community to better understand potential risk and associated vulnerability to hazards.

The planning team developed the natural hazard risk assessment for each member jurisdiction in three main steps: 1) hazard analysis, 2) vulnerability assessment, and 3) capability assessment. This information provides the framework for the PHMPC to develop and prioritize mitigation strategies and plans to reduce the risks and vulnerabilities that the region's communities may encounter from future hazard events.

The multiple-hazard identification and risk assessment processes evaluate the location, extent, magnitude, probabilities, and likelihood of the occurrence of hazards. While there are many hazards that could potentially affect the region, certain hazards are more likely to cause significant damage than others. This analysis attempts to measure these potential impacts and identify the hazards that create the greatest possible risks.

The second phase in this process is the vulnerability assessment, which estimates the extent of injury and damages that may result from a hazard that occurs within the member jurisdiction. The vulnerability assessment also examines the region's existing and future land uses, development trends, and demographics within the identified hazard areas, so that the impacts of future disasters can be lessened.

The third phase of this process includes the capability assessment. The capability assessment will provide the member jurisdiction with a better understanding of preparedness levels and capability to mitigate against natural hazards.

The capability analysis is a key element in developing suitable goals and objectives for mitigation. Because mitigation is most effective at protecting development that does not yet exist, a community's development trends can provide direction, incentive and alternatives to placing new development at risk from natural hazards. Furthermore, a careful analysis of existing capabilities increases the likelihood of identifying practices that could potentially *increase* the impacts of hazards upon the communities. A properly conducted mitigation capability assessment can also demonstrate potential gaps that hinder mitigation programming or highlight policy needs that could enhance mitigation programming.

Each community's capability with regard to natural hazard mitigation was examined through interviews with key personnel, data collection, and examination of regulations. The following sample matrix was completed for each of the five Peninsula communities, and was used to trigger discussion about existing policies, regulations, and processes for numerous hazards.

Explanation of Sample Capability Assessment Matrix (as shown in Table 5)

Comprehensive Plan: Comprehensive Long-Term Community Growth Plan
Land Use Plan: Plan that designates type of land use desired/required for individual parcels; often based on Zoning.
Subdivision Ordinance: Regulations that dictate lot size, density, setbacks, construction type and other parameters for large developments.
Zoning Ordinance: Regulations that dictate acceptable uses for individual parcels; may be tied to Land Use Plan.
Floodplain Management Ordinance: Directs development in identified Flood Hazard Areas. Required for participation in NFIP.
Substantial Damage Language: Provision of Floodplain Management Ordinance requires existing construction be brought into compliance if structure is damaged/improved by more than fifty percent of its value.
Certified Floodplain Manager: Association of State Floodplain Managers' designation for professionally certified floodplain managers.
Number of Flood-Prone Buildings: Number of buildings in the mapped Special Flood Hazard Area.
Number of NFIP policies: Number of buildings insured against flood damage through the NFIP.
Number of Repetitive Losses: Number of properties with multiple flood insurance claims in past ten years.
CRS Rating: Community Rating System of the NFIP is an incentive program that rewards communities for regulations/programs that exceed NFIP minimums through premium reductions for insured.
BCEGS: Building Code Effectiveness Grading System Rating assesses the building codes in effect and how they are enforced, with special emphasis on mitigation of losses from natural hazard.
Emergency Operations Plan: Disaster Response Plan focuses on different disaster types and scenarios.
Hazard Mitigation Plan: Plans such as this may address different types of hazards, including natural hazards, man-made hazards, others as defined by a particular jurisdiction.
Warning: Warning systems in place in a community, including NOAA Weather Radio reception, outdoor sirens, Cable Override, Flood Warning System, or Emergency Warning Notification System.

Table 5- Capability Matrix (Example)

	Town of HAZARDVILLE
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	Yes
-Effective Flood Insurance Rate Map Date	22-July-77
-Substantial Damage Language	Yes
-Certified Floodplain Manager	No
-Number of Flood-prone Buildings	0
-Number of NFIP policies	0
-Maintain Elevation Certificates	No
-Number of Repetitive Losses	0
CRS Rating	No
Stormwater Program	Yes
Building Code Version Full-time Building Official	USBC 2000 Edition (based on IBC)
- Conduct "As-built" Inspections	Yes
- BCEGS Rating	TBD
Local Emergency Operations Plan	Yes
Hazard Mitigation Plan	
Warning Systems in Place	Yes
-Storm Ready Certified	No
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	Yes
-Emergency Notification (R-911)	Yes
-other (e.g., cable override)	Yes-Cable-Emergency Alert System
GIS system	No
-Hazard Data	N/A
-Building footprints	N/A
-Tied to Assessor data	N/A
-Land Use designations	N/A
Structural Protection Projects	No
Property Owner Protection Projects	Acquisitions
Critical Facilities Protected	No
Natural Resources Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

GIS: Geographic Information System, or geographic databases interfaced with community mapping to provide enhanced planning and response capability.
Structural Protection Projects: Constructed flood protection, such as levees, drainage facilities, detention/retention basins.
Property Protection Projects: Non-structural flood protection through acquisition, elevation of structures, or flood proofing.
Critical Facility Protection: Previous community projects to protect critical facilities May include protection of power substations, sewage lift stations, water-supply sources, the EOC, police/fire stations or medical facilities.
Natural and Cultural Inventory: Inventory of resources, maps, or special regulations to protect natural or cultural resources; examples include wetlands, steep slopes or historic structures.
Erosion or Sediment Control: Regulations to protect streams and waterways from sediment contributions originating from construction, runoff, or other sources.
Public Information or Environmental Education Program: Ongoing programs providing information to the public on hazards, environmental awareness, and emergency preparation. May include flyers in city utility billings, a website, or an environmental education program for students.

The mitigation capabilities of each community are individually identified and included as part of each community profile.

5.1 City of Hampton Profile

The following sections present a detailed assessment of critical hazards that affect the City. Understanding these hazards will assist the Peninsula region in its process of identifying specific risks and developing a mitigation strategy to address those risks.

5.1.1 Flooding – City of Hampton

The City of Hampton's geographic location makes it extremely susceptible to coastal flooding. Storms associated with coastal flooding include tropical cyclones and nor'easters. These types of events typically drop large amounts of rain and generate high winds that result in storm surge. Storm surge is the water that is pushed toward the shore by the persistent force of the winds of an approaching storm. Astronomical tides occur independently of climactic conditions. Depending on the tide level at the time of landfall, storm surge may be elevated due to high tides or spring high tides. Flash flooding and urban flooding are also a concern within the city limits.

As part of the NFIP, FEMA has created a Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for the City of Hampton, dated July 16, 1987. The NCDC tracks the occurrence of flooding events for communities across the nation. The City of Hampton has developed surge elevations for its parcel data set. All of these data sources were utilized in developing this hazard identification and vulnerability assessment.

The FIRMs, which accompany this FIS, delineate the 100- and 500-year flood hazard boundaries for flooding sources identified in areas of growing development or areas predicted to have future development, at the time of the report. A detailed wave height analysis was developed in order to delineate the 100- and 500 year flood hazard boundaries for the city. The 100-year flood has a one percent chance of occurrence of being equaled or exceeded in any given year; a 500-year flood has a 0.02 percent annual chance of occurrence. This analysis resulted in a 100-year stillwater elevation of 8.5 feet for Hampton, and a maximum 100-year wave crest of 11 to 13 feet. The full FIS provides a detailed description of methods and assumptions. The significant flood events outlined in the FIS are provided below in Table 5.1.1a.

Table 5.1.1a -Significant Flood Events

City of Hampton Flood Insurance Study

Date	Storm	High Water Elevations
August 1933	Chesapeake - Potomac Hurricane	Max tide heights averaged 8 feet
April 1956	Nor'easter	Not provided
October 1957	Hurricane – Not named	Not provided
September 1960	Hurricane Donna	Not provided
March 1962	Nor'easter, Ash Wednesday Storm	Max tide heights averaged 6.8 feet

Source: FEMA 1987

The NCDC, operated by NOAA, keeps a record of significant weather related events and damage estimates for the entire country. Listed below are the most significant events that have affected the City of Hampton since the FIS was developed (1987); (Table 5.1.1b).

Table 5.1.1b - NCDC Significant Flood Events –City of Hampton

Date	Event	Precipitation	Comments
September 15 to 17, 1999	Hurricane Floyd	12-18 inches	▪ Numerous roads washed out due to flooding ▪ Flooding considered 500-year flood ▪ Enormous crop damage
October 17 to 18, 1999	Hurricane Irene	4-7 inches	▪ Numerous flooded roads and road closures
July 24, 2000	Flash Flood	Torrential Rain	▪ Up to 35 residences had to be evacuated due to high water
June 14, 2002	Flash Flood	Not provided	▪ Numerous reports of street flooding ▪ Water shooting out of manholes
August 28, 2002	Flash Flood	2 to 3 inches in 3 hours	▪ Caused road closures
September 3, 2003	Flash Flood	Not provided	▪ Many roads flooded
September 18, 2003	Hurricane Isabel	4-7 inches	▪ Severe Flooding ▪ Trees down ▪ Power Outage
August 30, 2004	Tropical Storm Gaston	Not provided	▪ Flooding occurred in the city

5.1.2 Hurricanes – City of Hampton

Virginia felt the effects of over 20 major hurricanes since the early 20th century. Most recently, the communities within the Peninsula area were damaged by Hurricanes Dennis and Floyd in September 1999 and Hurricane Isabel in September 2003.

Hurricane Dennis set the stage for its successor, Hurricane Floyd, by deeply saturating the soil throughout the Peninsula. An erratic Dennis lingered off the North Carolina coast for several days between August 31 and September 5, 1999, dumping 3.3 inches of precipitation at Norfolk Airport, with even higher totals inland. Shortly thereafter, on September 16, Hurricane Floyd moved through the Peninsula area dropping four to five inches of rain within 24 hours and generating winds in excess of 40 mph. Storm precipitation in Hampton totaled 7.5 inches, and throughout the Peninsula, trees and power lines were knocked down, roads flooded, and over 5,500 homes were left without power. The havoc produced by the two events in such short succession surely amplified their effects.

Hurricane Isabel made landfall on September 18, 2003 as a Category 2 hurricane near Drum Inlet, North Carolina. Hurricane Isabel is considered to be one of the most significant tropical cyclones to hit this area since Hurricane Hazel (1954) and the Chesapeake-Potomac Hurricane of 1933. Isabel produced storm surges 6 to 8 feet above normal high tide levels and was directly responsible for 10 deaths in Virginia and indirectly responsible for 22 deaths. Isabel caused widespread wind and storm surge damage in eastern North Carolina and southeastern Virginia, currently estimated at $925 million in Virginia. All of the above data was taken from the NOAA Tropical Cyclone Report for Hurricane Isabel (Beven and Cobb, 2004).

Coastal flooding from Isabel at Buckroe Beach, Hampton

In Hampton, the Buckroe and Grandview areas were particularly hard hit by Isabel. In Grandview, estimates of at least $4 million damage to older 1940s style homes and cottages were reported, with the majority of the older homes being significantly damaged or destroyed. (FEMA 2004) Isabel's storm surge exceeded the 1933 surge in some areas, and fell short in others. At King Street and Mercury Boulevard, the Isabel surge was at least two feet shy of the 1933 storm, but at Ft. Monroe, the storm surge in 2003 was at least 2.5 feet higher. At Fox Hill, Isabel brought an additional 12 inches of surge to the area. Forecasters at the National Hurricane Center in Miami attributes Isabel's wrath to the fact that the storm's right front quadrant lashed the Peninsula and the wind stayed out of the east for an extended period, resulting in water piling up in the extended reaches of many rivers and creeks. Much of the damage from felled trees in Isabel can be attributed to the immense precipitation experienced prior to September 2003; the summer of 2003 had nearly two times the total prior to the 1933 storm. (*Daily Press*, 8/23/03, *Daily Press* 9/29/03)

5.1.3 Tornados – City of Hampton

The City of Hampton has experienced four tornados over the period of 1979 to 2004 (Table 5.1.3), which have caused a variety of damage. The four tornados identified on the NCDC dataset consisted of one F0 and two F2s. The most significant tornado, an F2, occurred on

September 4, 1999, preceding Hurricane Dennis. This tornado caused extensive structural damage to a three block area. As a result, fifteen people were injured (six seriously) and three apartment complexes and an assisted living facility were condemned. Total damages were estimated at $7 million. No crop damage was reported.

A tornado struck Newport News a little past 3 p.m. on August 6, 1993. A man on the James River Bridge saw three funnel clouds over the river. Two dissipated and the third touched down moving through the woods on the Newport News side of the river. The tornado tracked 12 miles through Newport News, Hampton and Langley Air Force Base. In Hampton, two people were injured, 85 homes were damaged, 8 condemned with damage costs near three-quarters of a million dollars. On Langley, the tornado damaged several F-15s parked at the end of a runway for an air show scheduled for the next day

Table 5.1.3 - Historic Tornados – City of Hampton

Date	Magnitude	Deaths	Injuries	Property Damage	Descriptions
September 5, 1979	F2	0	9	$250,000	• Unroofed a home and damaged 27 others (Watson 2004c) • Spawned by Hurricane Davis (Watson 2004c)
August 6, 1993	Not reported	0	2	$750,000	• 85 homes damaged; 8 condemned • F-15s at LAFB damaged
September 4, 1996	F0	0	1	$1,000	• Minor damage
September 4, 1999	F2	0	6	$7.7 million	• Extensive structural damage to 3 block area • 3 apartment complexes and 1 assisted living complex condemned • 2 additional apartment complexes partially condemned • 460 persons forced to evacuate • 800 vehicle damaged • Occurred ahead of hurricane Dennis
August 30, 2004	Not reported	0	0	Not reported	• Minor tornado from Gaston

5.1.4 Wildfire – City of Hampton

Many wildfires are caused through human acts, both intentional (i.e. arson) and accidental. They can also be started through natural occurrences, such as lightning strikes. Wildfire danger can vary greatly season to season and is often exacerbated by dry weather conditions. Because of wild fire risk, VDOF has provided new information on identifying high-risk fire areas. Their Fire Risk Assessment Map was designed to help communities determine areas with the greatest vulnerability to wildfire.

The proximity of the tree lines or brush to the highway or roadway is also included in the wildfire risk analysis to capture the human/wildfire causal relationship. Travel corridors increase the probability of human presence across a landscape, thereby increasing the probability of wildfire ignition. As such, areas closer to roads are much more likely to attain a higher ignition probability. (NWUIFPP updated).

The Wildfire Risk Assessment Map in Appendix B, as well as the large-format Multi-Hazard Map for Hampton attached to this report, delineates the aerial extent of wildfire vulnerability within the City of Hampton, based on VDOF fire risk assessment data. Parameters used to establish these risk boundaries are land use, population density, slope, land cover and proximity to roads. The map shows that approximately seven percent of the city is located in the high wildfire risk zone. No fire incidences have been reported with the city limits by the VDOF for the time period of 1995-2003.

5.1.5 Vulnerability Assessment – City of Hampton

The PHMPC conducted a vulnerability analysis for each natural hazard that was identified as critical with medium to high hazard potential. These hazards include: flooding, hurricanes, tornados, and wildfire. This section describes the methodology used to perform the vulnerability analysis for each hazard and then lists the results of this analysis. The vulnerability assessment investigated the following:

- Number and value of at risk structures;
- Number of at risk critical facilities; and,
- Extent of at risk critical infrastructure.

Flooding – City of Hampton

The City GIS Office provided a digital parcel polygon layer containing attribute fields that included a FEMA flood hazard designation and improvement values. This database was queried to determine which parcels were within 100-year flood hazard boundaries. The improvement values of these parcels were then totaled.

From the vulnerability analysis it was determined that 11,120 parcels are designated as Zone AE, 348 parcels were designated as Zone VE, and 23 were designated as Zone A. All of these zones represent the one percent annual chance (100-year) flood hazard as defined by FEMA. There were a total of 50,252 parcels in the database. The analyses found that approximately 23 percent of these parcels are designated with 100-year flood hazard. The City assessor's database provided by the city included a general designation for each parcel, indicating "dwelling", "commercial", "other" or "no value". Table 5.1.5a provides a summary of the analysis.

Table 5.1.5a - Summary of Flood Analysis – City of Hampton

Parcel Designation	Number of Parcels	% of Total Land Area	Parcels in 100-yr Floodplain	Improvement Value
Dwelling	42,056	84	10,815	$1,124,810,600
Commercial	1,977	4	391	$2,067,112,700
Other (*e.g.,* boathouse, garage)	538	1	285	$20,001,300
No Value/Vacant	5,681	11	N/A	N/A
Total	**50,252**	**100**	**11,491**	**$3,211,924,600**

FEMA developed a concept to highlight the impact that repetitively flooded structures have had on the NFIP. The term "repetitive loss," as applied to the NFIP, refers to any property for which two or more flood insurance claims in excess of $1,000 each in a 10-year period of time have been paid. In 1998, FEMA reported that the NFIP's 75,000 repetitive loss properties had already cost $2.8 billion in flood insurance payments and numerous other flood prone properties continue to remain at high risk in the Nation's floodplains. While these properties make up only one percent of the flood insurance policies currently in force, they account for 30 percent of the country's flood insurance claim payments. A report on repetitive loss structures completed by the National Wildlife Federation found that 20 percent of these structures are listed as being outside of the 100-year floodplain (Conrad et al. 1998).

FEMA has identified 160 structures as repetitive loss structures in the City of Hampton. The structures are valued at over $19.5 million, collectively. Losses span the time period from April 1978 through September 2003 (Hurricane Isabel). Total flood insurance payments for buildings and contents over that period are $6.6 million, or 18 percent of the total payments made to all Hampton properties in that time. City planners have identified specific areas of the city that contain large numbers of repetitive losses; however, in order to protect the privacy of those policyholders, that information cannot be shared in this plan.

Hurricane – City of Hampton

Hazards U.S. – Multi Hazard (HAZUS$^{®MH}$) was utilized to perform a wind hazard analysis for the entire Peninsula region. HAZUS$^{®MH}$ software is a multi-hazard loss estimation program that was developed under a cooperative agreement between the National Institute of Building Sciences and FEMA. The current version of HAZUS$^{®MH}$ has the ability to calculate earthquake, wind, and flood hazards as well as potential economic losses associated with these hazards. The software is designed with the flexibility to perform loss estimations at three different levels. Level 1 utilizes all default parameters built into the software. Levels 2 and 3 require user-defined scenarios and building inventory data. For the purposes of this plan, a Level 1 wind analysis was performed to calculate the wind hazard for Hampton. The probabilistic scenario was used for this analysis. This scenario activates a database of many thousands of storm tracks and intensities, and generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year.

Table 5.1.5b lists the total dollar value of exposed structures for the City of Hampton. The default data set provided with the HAZUS$^{®MH}$ software is based on the 2002 U.S. Census data. This analysis is based on the probability of occurrence and can generally be used to estimate potential damages from high winds despite development trends that may have impacted population since 2002.

Table 5.1.5b-Value of Structures Exposed to High Wind – City of Hampton

Occupancy Type	Total Value of Exposed Structures (in $1,000)
Residential	$7,243,284
Non-Residential	$1,100,057
Total	**$8,343,341**

Based on HAZUS$^{®MH}$.

The probabilistic analysis generated with the HAZUS$^{®MH}$ software utilized the same building stock information listed in Table 5.1.5a. The probabilistic scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year. The probabilistic method was used to generate loss estimations of storms with specific recurrence intervals: 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year. Since residential structures comprised a significantly large percentage of the occupancy classification, these data are presented in Table 5.1.5c below.

Table 5.1.5c-Summary of Probabilistic Analysis – Residential Structures – City of Hampton

Return Period	Residential Building Damage – Number of Buildings			
	Minor	Moderate	Severe	Destruction
10-year	42	4	0	0
20-year	449	48	9	0
50-year	6,069	1,034	148	35
100-year	12,906	4,896	1,057	739
200-year	15,238	7,334	1,816	1,273
500-year	14,693	11,004	4,457	3,632
1000-year	10,263	12,075	8,424	8,798

A consistent problem with these data is evident here, and that is that NOAA, USACE and HAZUS-MH do not provide a clear relationship between return periods and categories of hurricanes.

Tornado – City of Hampton

Four tornado events were reported for the City of Hampton. The random nature of these events renders them difficult to predict; therefore, conducting a vulnerability analysis is difficult. The entire city has equal statistical probability of experiencing a tornado. Historic occurrences of tornados in the region show the severity of tornados typically range from F0 to F3 on the Fujita Scale, but the likelihood of a bigger tornadic event cannot be discounted.

The facilities and building stock that were identified as exposed under the hurricane hazards above are also exposed to tornado hazards. Tornados are random natural events that strike with little warning but are associated with thunderstorms and tropical weather such as hurricanes.

Wildfire - City of Hampton

The Wildfire Risk Assessment data, provided by the VDOF, was utilized to estimate the wildfire risk for the City of Hampton. The Wildfire Risk Map (Appendix B) shows that approximately seven percent of the city is in a high risk area. This data layer was overlaid with the city parcel mapping in order to estimate the value of at-risk structures. The VDOF also provided the number of wildfire incidences reported from 1995-2003.

According to the VDOF, zero incidences of wildfire were reported for the City of Hampton from 1995-2003. There are 456 parcels that intersect the high wildfire hazard zone. The parcels have a total improvement value of $986,342,500.

Critical Facilities Analysis – City of Hampton

In order to assess the vulnerability of a community to natural hazards, the PHMPC conducted an inventory of the Peninsula area structures and critical facilities (Appendix E). Critical facilities are those facilities that warrant special attention in preparing for a disaster and/or facilities that are of vital importance to maintaining citizen life, health, and safety during and/or directly after a disaster event.

The inventory of critical facilities for the City of Hampton includes emergency response facilities such as police stations, fire departments, emergency medical service stations (EMS), public facilities including schools and local government buildings. The code and number provided in Table 5.1.5f identify these facilities on the all-hazard mapping provided in Appendix F. Those facilities that are geographically located within an identified hazard zone are listed in Tables 5.1.5d, 5.1.5e, and 5.1.5f.

Table 5.1.5d -Critical Facilities at Risk – 100-Year Floodplain

Name	Code	Number
Station 5	FR	10
Fire Administration	FR	12
Fire Training Center	FR	13
Police Headquarters	PO	4
Police Field Office	PO	6
Gloria Dei Lutheran School	SC	9
Syms Middle School	SC	34
Burbank Elementary School	SC	42
Cooper Elementary School	SC	1
Tyler Elementary School	SC	38
Barron Elementary School	SC	44
Spratley Middle School	SC	32
Mary Peake – Y.H. Thomas Center	SC	20
Tarrant Elementary School	SC	35
Wythe Elementary School	SC	40

Source: AMEC
Critical Facility Key Code, see Appendix E

Table 5.1.5e-Critical Facilities at Risk –Surge Zone Hurricane Category 4

Name	Code	Number
Station 9	FR	3
Station 3	FR	8
Sentara Careplex	HO	3
Kecoughtan Court	PO	8
Briarfield	PO	9
New Horizon Regional Education Center	SC	23
Hampton High School	SC	11
Robert E Lee Elementary School	SC	29
New Mount Olive Christian Academy	SC	24
Lindsay Middle School	SC	17
Bassette Elementary School	SC	51
Emmanuel Grace Baptist Church	SC	4
Bradford Hall	SC	53
Wythe Elementary School	SC	40

Source: AMEC
Critical Facility Key Code, see Appendix E

Table 5.1.5f-Critical Facilities at Risk - High Wildfire Hazard Zone

Name	Code	Number
Thomas Nelson Community College	SC	36
New Horizon Regional Education Center	SC	23

Source: AMEC
Critical Facility Key Code, see Appendix E

5.1.6 Capability Assessment – City of Hampton

As an additional tool to assist with the examination of the hazards identified and to evaluate the community's ability to plan, develop, and implement hazard mitigation activities, the planning team assessed Hampton's existing mitigation capabilities. This assessment is designed to highlight both the codified, regulatory tools available to the community to assist with natural hazard mitigation as well as other community assets that may help facilitate the planning and implementation of natural hazard mitigation over time. The following Capability Assessment Matrix was used as a basis for the City of Hampton's mitigation plan.

Table 5.1.6 - Capability Matrix – City of Hampton

	City of Hampton
Comprehensive Plan	Yes, 12/89
Land Use Plan	Yes, part of Comp. Plan
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	Yes
-Effective Flood Insurance Rate Map Date	7-3-95
-Substantial Damage Language	Yes
-Certified Floodplain Manager	No
-Number of Floodprone Buildings	11,491
-Number of NFIP policies	9,792 (85%) as of 6/04
-Maintain Elevation Certificates	Yes
-Number of Repetitive Losses	160
CRS Rating	none
Stormwater Program	Yes
Building Code Version Full-time Building Official	VUSBC (IBC 2003) Yes
- Conduct "As-built" Inspections	Yes
- BCEGS Rating	2
Emergency Operations Plan	Yes
Hazard Mitigation Plan	Pending
Warning Systems in Place	Yes
-Storm Ready Certified	Yes
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	No
-Emergency Notification (R-911)	Yes
-other (e.g., cable override)	Yes – cable override
GIS system	Yes
-Hazard Data	Yes
-Building footprints	Yes

	City of Hampton
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	Yes
Property Owner Protection Projects	Yes
Critical Facilities Protected	Not all facilities fully protected.
Natural Resources Inventory	No
Cultural Resources Inventory	Yes, partial inventories
Erosion Control Procedures	Yes, by State law
Sediment Control Procedures	Yes, by State law
Public Information Program/Outlet	Yes, Emerg Mgmt & Public Works & CERT
Environmental Education Program	Yes, Public Works

Form of Governance

Hampton has a Council – Manager form of government. The Hampton City Council is composed of seven elected members, including an elected Mayor. The Council selects the Vice Mayor after each election. Elections are held on the first Tuesday in May. Council members are elected to four-year terms in staggered elections in even years. The Council appoints a City Manager who administers day-to-day city services and directs city agencies.

Guiding Community Documents

The City of Hampton has a range of guidance documents and plans for each of their departments. These include a comprehensive plan, 15 neighborhood/small area plans, capital improvement plans, and emergency management plans. The City uses building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the municipality guides its future is through policies laid out in the Comprehensive Plan.

Comprehensive Plan 2010

The Code of Virginia requires all cities and counties in the state to have a comprehensive plan and to review it every five years to determine if revisions are necessary. The City of Hampton's *Comprehensive Plan 2010* was adopted in 1989 and is the responsibility of the Department of Planning. The document features the following:

- The plan presents long-range intentions regarding the direction and nature of future development, assesses current conditions and incorporates citizen desires into long-range public policy.
- Comprised of six elements that focus on aspects of future development: Land Use, Transportation, Community Facilities, Environment, Housing, and Urban Design.
- Environmental element focuses on Chesapeake Bay water quality, balancing environmental restraints and development needs, stormwater management, protecting and enhancing water access, and the need for inventories of significant natural resources.
- Plans for continued growth and development and urban design in designated growth/redevelopment areas, including:

    - Coliseum Central
    - Downtown Hampton
    - Buckroe Beach
    - King Street Corridor
- Plans for necessary transportation enhancements and improvements to service projected growth
- Plans for operation and expansion of public facilities to accommodate expected growth in the City, including bikeways, playgrounds, and pools.
- The City is currently working to adopt a new ten year plan, *the City of Hampton Community Plan*. This plan will be adopted in the Fall of 2005.

Zoning & Development Standards

- Identifies existing federal and state regulations for wetland, floodplain, and RPA/RMA protection.
- The document outlines required standards for new development and redevelopment based on use and zoning designation.

The City of Hampton has adopted the minimum requirements of the NFIP by designating the Flood Zone District as a Special Public Interest District in Zoning Ordinance §17.3-31. The community has 160 repetitive losses through the NFIP, 15 of which were constructed after the community's flood hazard areas were mapped (post-FIRM). Structures in A Zones must be constructed at or above the Base Flood Elevation, and structures in V-Zones must have their lowest horizontal structural member elevated to or above the base flood elevation, which includes an additional three feet for wave height. The Department of Codes Compliance enforced requirements for "substantially damaged" homes after Hurricane Isabel, but the process was exceedingly difficult and some difficult decisions had to be made. The City's Building Permit application includes a notation regarding the map panel and zone designation, and a space for the Finished Floor Elevation. Permit applications and parcel information are all available online. The parcel information includes flood hazard area designation.

A Site Plan Review Committee for new development is made up of representatives from Public Works, Division of Fire and Rescue, Police Division, Planning Department, Codes and Compliance, and any other department that the Director of Public Works deems necessary to review proposed plans. During the review of new site plans, recommendations concerning the plan may be made and any such suggestions shall be reported to the City Manager when the plan is submitted for review. The committee is tasked with the responsibility of reviewing the plan to ensure its compliance with the City's building, structure, and safety codes. The Police Division is tasked with ensuring that Crime Prevention through Environmental Design (CPTED) is achieved. This is accomplished by ensuring appropriate lighting and landscaping design, while minimizing design barriers that may result in unsafe or unlawful activities. The Office of Emergency Management is not involved in the Site Plan Review Committee.

Stormwater Program and Fees

The City's stormwater fee is a result of the Federal Clean Water Act of 1987, which mandated that cities of 100,000 or more persons reduce pollution before it reaches the Chesapeake Bay. Hampton established the stormwater fee because no Federal or state dollars were provided to implement water quality measures in accordance with the Federal mandate.

Monies from the stormwater fee are used to fund many programs related to water quality including environmental education, street sweeping, capital improvements to the system, drainage maintenance, administration, review of permits, inspection, and monitoring activities.

Public Education

Among the readily available public outreach mechanisms for the City of Hampton, the City's website (http://www.hampton.gov) provides residents with pertinent information, provides an on-line complaint form, property information tool, and answers numerous Frequently Asked Questions (FAQs). The City also posts most of its guiding documents, including the Comprehensive Plan on this site. The City provides special training to property owners via the Codes Academy and the City's Neighborhood College Leadership Institute. Emergency Preparedness information is also disseminated through the City PIO's eNews, free e-mail briefs about what's happening in Hampton, and the City's local cable channel, Channel 47.

The City of Hampton is the first locality in Virginia to establish a centralized 3-1-1 customer call center that offers citizens round-the-clock access to city services and information. Residents within the city limits dial 3-1-1 and reach the voice of call center staff. Residents with cell phones may also access 3-1-1. Those citizens outside of the city limits may access the customer call center by calling 727-8311. Customer Advocates (call-takers) help with everything from reporting a missed trash collection to potholes to answering questions about the city budget or inquiries about a community center's hours.

The City's Department of Public Works has many different types of educational materials available for Hampton residents, businesses, teachers, youth, and adult groups. Materials may include coloring books, posters, promotional magnets, environmental tip sheets, and guides to all environmental services in Hampton. The Hampton Watershed Restoration Project offers annual waterway clean-ups, Chesapeake Bay friendly seminars, Adopt-a Stream cleanup, storm drain marking, environmental ambassador efforts and public education activities.

Emergency Preparedness

Emergency Alert System (EAS) is a national civil emergency alert system that uses message relays between member radio and television stations to inform the public about immediate threats to national security, life, and property. EAS is used for severe weather warnings and can also be employed to disseminate Amber Alerts for missing children. The enhancement is an initiative of Governor Warner's Secure Virginia Panel designed to improve statewide preparedness, response, and recovery capabilities for emergencies and disasters. Governor Mark R. Warner announced June 5, 2004, that Virginia will enhance its public warning capabilities with a new satellite-based system that can rapidly transmit EAS messages throughout the Commonwealth.

Storm Ready – As of February 2005, the National Weather Service has certified only five Virginia communities as "Storm Ready", including Hampton, Newport News, Danville, Fairfax County and Loudoun County. Storm Ready is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle severe weather. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations. To be officially Storm Ready, a community must:

- Establish a 24-hour warning point and emergency operations center;
- Have more than one way to receive severe weather warnings and forecasts and to alert the public;
- Create a system that monitors weather conditions locally;
- Promote the importance of public readiness through community seminars; and,
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

Hampton Citizen Corps – The Hampton Citizen Corps is part of the Virginia Corps that creates opportunities for individuals to volunteer to help communities prepare for and respond to emergencies by bringing together local leaders, citizen volunteers and organizations. Hampton's Citizen Corps includes three core programs: Neighborhood Watch, Volunteers in Police Service (VIPS), and Community Emergency Response Team (CERT). Medical Reserve Corps (MRC) is under development.

CERT, which is the core program most relevant to hazard mitigation, helps communities respond to disasters during the first 72 hours following an event when flooded roads, disrupted communications, and emergency demand outweigh local emergency services. The purpose of CERT training is to provide private citizens with basic skills to handle virtually all of their own needs and then to respond to their community's needs in the aftermath of a disaster.

Other Mitigation Activities

Prior to Hurricane Isabel, placement of the geotube and beach nourishment at the north end of Buckroe Beach was the largest flood mitigation project financed by the City. Since 2001, the City has purchased eight inland structures in Buckroe with plans to install a dry stormwater pond in the area. One fire station remains in the floodplain (Fox Hill Fire Station, engine bay only), and at least one substation is located in the floodplain in the Fox Hill area.

Since Hurricane Isabel (September 2003), approximately 12 scattered residential structures have been elevated to at least the Base Flood Elevation with homeowner financing and Increased Cost of Compliance (ICC) funds. The City's Codes Compliance Department issued over 50 letters to homeowners providing eligibility for the NFIP's ICC program for insured structures. Two post-Hurricane Isabel FEMA HMGP project requests were submitted to elevate a total of 27 homes in Buckroe, Grandview, Chesapeake Avenue and the Coliseum Central areas. One grant has been approved, and the other denied. At the time of this report, the project is in the procurement phase. Several other HMGP projects have been proposed and rejected regarding relocating the school maintenance facility at Windmill Point, beachfront restoration at Buckroe Beach, seawall reconstruction at Chesapeake Avenue, and generator-wiring of critical facilities.

The City of Hampton plans to expand and improve Newmarket Creek Park. Newmarket Creek watershed has a significant history of flooding. The improved park will include additional designated open space in the floodplain, and additional canoe launches and docking areas in an effort to improve recreational access to local waterways.

The City's Household Chemical Collection Program is a drop-off program sponsored by the City of Hampton and the Virginia Peninsula's Public Service Authority (VPPSA) to serve residents in the City of Hampton for the disposal of household chemicals. This program helps remove aging hazardous chemicals from residences throughout Hampton, including areas that could be affected by flooding.

5.2 City of Newport News Profile

The following sections present a detailed assessment of critical hazards that affect the City of Newport News. Understanding these hazards will assist the Peninsula region in its process of identifying specific risks and developing a mitigation strategy to address those risks.

5.2.1 Flooding – City of Newport News

The geographic location of the City of Newport News makes it extremely susceptible to coastal flooding. Storms associated with coastal flooding include hurricanes and nor'easters. These types of events typically drop large amounts of rain and generate high winds that result in storm surge. Storm surge is essentially the water that is pushed toward the shore by the persistent force of the winds of an approaching storm. Astronomical tides occur independent of climactic conditions. Depending on the tide level at the time of landfall, storm surge may be elevated due to high tides or spring high tides. Flash flooding and urban flooding are also a concern within the City limits.

As part of the NFIP, FEMA created a Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for the City of Newport News. In addition, the NCDC tracks the occurrence of flooding events for communities across the nation. All of these data sources were considered in developing the hazard identification and vulnerability assessment.

FEMA published a FIS for the City of Newport News, dated January 17, 1986. The FIRMs, which accompany this FIS, delineate the 100- and 500-year flood hazard boundaries for flooding sources identified in areas of growing development or areas predicted to have future development, at the time of the report. A detailed wave height analysis was developed to in order to delineate the 100- and 500-year flood hazard boundaries for the City. This analysis resulted in a 100-year stillwater elevation of 8.5 feet for the City and a maximum 100-year wave crest of 11 to 13 feet. Refer to this report for a detailed description of methods and assumptions. The significant flood events outlined in the FIS are given below in Table 5.2.1a.

Table 5.2.1a-Significant Flood Events

City of Newport News Flood Insurance Study

Date	Storm	Tide Elevations
August 1933	Hurricane	Max tide heights averaged 8 feet
April 1956	Nor'easter	Not given
October 1957	Hurricane – Not Named	Not given
September 1960	Hurricane Donna	Not given
March 1962	Nor'easter	Max tide heights averaged 6.8 feet

Source: FEMA 1986

The NCDC, operated by NOAA, keeps a record of significant weather related events and damage estimates for the entire country. Listed below (Table 5.2.1b) are the significant events that have affected the City of Newport News.

Table 5.2.1b- NCDC Listed Significant Flood Events –City of Newport News

Date	Event	Precipitation	Comments
September 15 to 17, 1999	Hurricane Floyd	12 to 18 inches	▪ Numerous roads washed out due to flooding ▪ Flooding considered 500-year flood ▪ Enormous crop damage
July 19, 2000	Flash Flood	Not given	▪ Heavy rain caused flooding and road closures

5.2.2 Hurricanes – City of Newport News

The FIS for the City of Newport News identified two historic hurricanes that affected the City (see Table 5.2.1b above); however, specific damage estimates were not given. The NCDC dataset listed five hurricanes for the City of Newport News for the period between 1950 to June 2004. These storms are listed in Table 5.2.2.

Table 5.2.2- Historic Hurricanes – City of Newport News

Date	Storm Name	Category	Descriptions
August 15, 1995	Felix	Not provided	▪ No major damage reported in VA ▪ Tides 2.0-2.5 feet above normal
July 12, 1996	Hurricane	Not provided	▪ None given
September 1, 1999	Dennis	Hurricane/Tropical Storm	▪ Prolonged period of tropical cyclone ▪ Highest sustained winds at Langley 52mph ▪ Generated F2 tornado ▪ Tide 3 feet above normal ▪ Coastal flooding ▪ 2 to 5 inches of rain ▪ $27,000 damage
September 15, 1999	Hurricane Floyd	Category 1/Tropical Storm	▪ Spawned 2 tornados ▪ Hundreds of downed tress ▪ Tide 3.9 feet above normal ▪ Numerous roads washed out ▪ $99.4 million in property damage over the entire affected area ▪ Flooded portions of I-64 in Newport News ▪ Flooded townhomes near Newport News Park; water up to 2nd floor in some cases
September 18, 2003	Hurricane Isabel	Category 1/Tropical Storm	▪ Damaged residents and businesses ▪ Greatest storm surge since Hazel ▪ Thousands of uprooted trees ▪ Debris damage to homes ▪ Heavy rain caused flooding and road closures ▪ Power outage ▪ Water contamination

Hurricane Floyd moved through the area in September 1999, dropping 16.57 inches of rain within 24 hours and generating winds in excess of 50 mph in Newport News. Throughout the Peninsula, trees and power lines were knocked down, roads flooded, and over 5,500 homes were left without power. There was damage done to Interstate 64, and flooding along Kiln Creek, Newmarket Creek and Salters Creek.

I-64 flooding in Newport News from Hurricane Floyd

Hurricane Isabel made landfall on September 18, 2003, as a Category 2 hurricane near Drum Inlet, North Carolina. Hurricane conditions affected portions of southeastern Virginia. Rainfall averaged four to seven inches over large portions of eastern North Carolina as well as east-central Virginia. Hurricane Isabel is considered to be one of the most significant storms to hit this area since Hurricane Hazel (1954) and the Chesapeake-Potomac Hurricane of 1933. Isabel produced storm surges six to eight feet above normal high tide levels and is directly responsible for 10 deaths in Virginia and indirectly responsible for 22 deaths. Isabel caused widespread wind and storm surge damage in eastern North Carolina and southeastern Virginia, currently estimated at $925 million in Virginia. All of the above data was taken from the NOAA Tropical Cyclone Report for Hurricane Isabel (Beven and Cobb, 2004).

Isabel caused 83 million dollars of damage in Newport News, knocked down over 44,000 trees and cut nearly 99 percent of the City's power. Most of the $83 million damage was residential and business losses in Newport News. The damage assessment report showed a significant amount of dollars used for debris clearance/removal to restore usage to roads, water facilities, and public buildings.

5.2.3 Tornados – City of Newport News

The City of Newport News has experienced seven tornados over the period of 1951 to 2001(Table 5.2.3), which have caused a variety of damage. The most significant tornado occurred on September 5, 1979, which generated high winds and caused some injuries in the affected area, which included neighboring areas.

A tornado struck Newport News a little past 3 p.m. on August 6, 1993. A man on the James River Bridge saw three funnel clouds over the river. Two dissipated and the third touched down moving through the woods on the Newport News side of the river. The tornado tracked 12 miles through Newport News, Hampton and Langley Air Force Base. In Newport News, eight people were injured, 163 homes were damaged, 12 were condemned and damage costs were $1.2 million.

Table 5.2.3- Historic Tornados – City of Newport News

Date	Magnitude	Deaths	Injuries	Descriptions
June 27, 1951	F1	0	0	▪ None Reported
April 6, 1958	F1	0	0	▪ None Reported
October 7, 1965	F0	0	0	▪ None Reported
September 5, 1979	F3	0	2	▪ None Reported
June 1, 1982	F0	0	0	▪ None Reported
August 6, 1993	Not available	0	8	▪ $1.2 million
August 11, 2001	F0	0	0	▪ Weak tornado damaging a couple of mobile homes and produced minor damage at a townhouse complex near Fort Eustis

5.2.4 Wildfire – City of Newport News

Many wildfires are caused by human acts, both intentional and unintentional. Wildfires are also started through natural occurrences, such as lightning strikes. Wildfire danger can vary greatly season to season and is often exacerbated by dry weather conditions. Because of wild fire risk, VDOF has provided new information on identifying high-risk fire areas. Their Fire Risk Assessment Map was designed to help communities determine areas with the greatest vulnerability to wildfire.

The Wildfire Risk Assessment Map in Appendix B, delineates the aerial extent of wildfire vulnerability within the City of Newport News, based on VDOF fire risk assessment data. The large format Multi-Hazard Map provided with this plan also delineates wildfire hazard areas for Newport News, specifically. Approximately 9 percent of the City falls in a high wildfire risk area. Parameters used to establish these risk boundaries are land use, population density, slope, land cover and proximity to roads.

The proximity of the tree lines or brush to the highway or roadway is also included in the wildfire risk analysis to capture the human/wildfire causal relationship. Travel corridors increase the probability of human presence across a landscape, thereby increasing the probability of wildfire ignition. As such, areas closer to roads are much more likely to attain a higher ignition probability.

5.2.5 Vulnerability Assessment – City of Newport News

The PHMPC conducted a vulnerability analysis for each natural hazard that was identified as critical with medium to high hazard potential. As several of these hazards are prone to occur in any part of the City, the exposure associated with tornados and winter storms is assumed to include the entire city. This section describes the methodology used to perform the vulnerability analysis for each hazard and then lists the results of this analysis.

Flooding – City of Newport News

The City of Newport News GIS Department provided tax parcel data including the tax assessor database and digital copies of the FEMA delineated floodplains for the City. The 100-year flood hazard boundaries delineated on the existing FEMA FIRM for the City include detailed, approximate and V-zones. These shapefiles were merged into a single 100-year flood hazard layer and intersected with the parcel layer provided by the City. Any tax parcel that intersected the delineated floodplain was considered as inside the floodplain and its building improvement value was added to the total property value in the 100-year floodplain.

The dataset provided by the City contained 53,585 parcels. Approximately 4,596 (9 percent) of these parcels intersect the 100-year flood hazard area. The total at risk value associated with these parcels is $2,586,130,866. This is approximately 27 percent of the total improvement value for the entire city.

FEMA has developed a concept to highlight the impact that repetitively flooded structures have had on the NFIP. The term "repetitive loss," as applied to the NFIP, refers to any property for which two or more flood insurance claims in excess of $1,000 each in a 10-year period of time have been paid. In 1998, FEMA reported that the NFIP's 75,000 repetitive loss properties had already cost $2.8 billion in flood insurance payments and numerous other flood prone properties continue to remain at high risk in the nation's floodplains. While these properties make up only one to two percent of the flood insurance policies currently in force, they account for 40 percent of the country's flood insurance claim payments. A report on repetitive loss structures completed by the National Wildlife Federation found that 20 percent of these structures are listed as being outside of the 100-year floodplain (Conrad et al. 1998).

Including flood insurance claims paid as a result of flood damage caused by Hurricane Isabel in 2003, FEMA has identified 20 structures as repetitive loss structures in the City of Newport News.

Hurricane – City of Newport News

Hazards U.S. – Multi Hazard (HAZUS$^{®MH}$) was utilized to perform a wind hazard analysis for Newport News. HAZUS$^{®MH}$ software is a multi-hazard loss estimation program that was developed under a cooperative agreement between the National Institute of Building Sciences and FEMA. The current version of HAZUS$^{®MH}$ has the ability to calculate earthquake, wind, and flood hazards as well as potential economic losses associated with these hazards. The software is designed with the flexibility to perform loss estimations at three different levels. Level 1 utilizes all default parameters built into the software. Levels 2 and 3 require user defined scenarios and building inventory data. For the purpose of this plan, a Level 1 wind analysis was performed to calculate the wind hazard for each Peninsula community. The software package also has the ability to analyze historic storm data or a probabilistic scenario. The probabilistic scenario activates a database of many thousands of storm tracks and intensities. This scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year.

Table 5.2.5a lists the total dollar value of exposed structures for the City of Newport News. The HAZUS$^{®MH}$ software is based on the 2002 Census data. Although current development trends in the Peninsula region may render the 2002 Census data somewhat obsolete, this analysis depicts the probability of occurrence and can generally be used to estimate potential damages due to high winds.

Table 5.2.5a- Value of Exposed Structures from HAZUS$^{®MH}$ – City of Newport News

Occupancy Type	Value of Exposed Structures ($1,000)
Residential	8,859,193
Non-Residential	1,679,920
Total	**10,539,113**

The probabilistic analysis generated with the HAZUS$^{®MH}$ software utilized the same building stock information listed above. The probabilistic scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year. The probabilistic method was used to generate loss estimations of storms with specific recurrence intervals: 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year. Since residential structures comprise a significantly large percentage of the occupancy classification, these data are presented in Table 5.2.5b below.

Table 5.2.5b-Summary of Probabilistic Analysis – Residential Structures – City of Newport News

Return Period	Residential Building Damage – Number of Buildings			
	Minor	Moderate	Severe	Destruction
10-year	72	7	0	0
20-year	719	96	18	0
50-year	5,112	958	171	11
100-year	6,078	1,519	270	49
200-year	15,780	7,151	1,407	602
500-year	16,231	12,985	5,012	3,315
1000-year	14,325	14,266	7,240	5,477

Tornado – City of Newport News

The facilities and building stock that were identified as exposed under hurricane hazards are also exposed to tornado hazards. Tornados are random natural events that strike with little warning but are associated with thunderstorms and hurricanes.

Wildfire – City of Newport News

The Wildfire Risk Assessment data, provided by VDOF, was utilized to estimate the wildfire risk for the City of Newport News. This data layer was intersected with the City's tax parcel mapping in order to estimate the value of at risk structures.

According to the VDOF Wildfire Risk Assessment mapping, approximately nine percent of the City is located within the high wildfire risk zone. There are 1,856 parcels that intersect with this high wildfire area, which results in an at risk building stock value of $1,388,486,700.

Critical Facilities Analysis – City of Newport News

In order to assess the vulnerability of a community to natural hazards, the PHMPC conducted an inventory of Newport News structures and critical facilities (Appendix E). Critical facilities are those facilities that warrant special attention in preparing for a disaster and/or facilities that are of vital importance to maintaining citizen life, health, and safety during and/or directly after a disaster event.

The inventory of critical facilities for the City of Newport News includes emergency response facilities such as police stations, fire departments, emergency medical service stations (EMS), public facilities including schools and local government buildings. The code and number provided in the table identify these facilities on the all-hazard mapping provided in Appendix F. Those facilities that are geographically located within an identified hazard zone are listed in Tables 5.2.5c, 5.2.5d, and 5.2.5e.

Table 5.2.5c- Critical Facilities in 100-Year Floodplain

Name	Code	Number_
Pump Station	PS	PS 014
Pump Station	PS	PS 030
Pump Station	PS	PS 031
Pump Station	PS	PS 037
Pump Station	PS	PS 044
Pump Station	PS	PS 049
Pump Station	PS	PS 053
Pump Station	PS	PS 089
Pump Station	PS	PS 087
Pump Station	PS	PS 096
Pump Station	PS	PS 097
Pump Station	PS	PS 123
Pump Station	PS	PS 135
Pump Station	PS	PS 143
Pump Station	PS	PS 145
Pump Station	PS	PS 161
Pump Station	PS	PS 163
Pump Station	PS	PS 056
Pump Station	PS	PS 068
Pump Station	PS	PS 072
Pump Station	PS	PS 078
Pump Station	PS	PS 079
Pump Station	PS	PS 002
Pump Station	PS	PS 008
Pump Station	PS	PS 013
Richard T. Yates Elem.	SC	26

Source: AMEC
Critical Facility Key Code, see Appendix E

Table 5.2.5d - Critical Facilities at Risk - Surge Zone Hurricane Category 4

Name	Code	Number
Calvary Sda School	SC	7
Parkview Christian Academy Day	SC	15
B. T. Washington Middle	SC	18
Dunbar-Erwin Elem.	SC	20
Huntington Middle	SC	23
John Marshall Elem.	SC	25
Richard T. Yates Elem.	SC	26
Pump Station	PS	PS 014
Pump Station	PS	PS 017
Pump Station	PS	PS 018
Pump Station	PS	PS 027
Pump Station	PS	PS 031
Pump Station	PS	PS 032

Name	Code	Number
Pump Station	PS	PS 033
Pump Station	PS	PS 034
Pump Station	PS	PS 037
Pump Station	PS	PS 038
Pump Station	PS	PS 039
Pump Station	PS	PS 049
Pump Station	PS	PS 051
Pump Station	PS	PS 053
Pump Station	PS	WWPFS
Pump Station	PS	WWPDV
East End Health Center	CL	11
Whittaker Hosp Medical Office	CL	12
Youth Campus Day Care	DC	20
Ding Dong Kindergarten	DC	21
Tic-Toc Kindergarten	DC	22
Quality Nursery & Garden Center	DC	23
Fire Warehouse	FR	3
Station 2	FR	10
Station 7	FR	11
Zion Baptist Convalescent	NH	3
Nursing Home	NH	12
Mdn Center	NH	13
Spratley Housing	NH	15
Pump Station	PS	PS 099
Pump Station	PS	PS 089
Pump Station	PS	PS 112
Pump Station	PS	PS 116
Pump Station	PS	PS 086
Pump Station	PS	PS 095
Pump Station	PS	PS 096
Pump Station	PS	PS 097
Pump Station	PS	PS 118
Pump Station	PS	PS 120
Pump Station	PS	PS 123
Pump Station	PS	PS 125
Pump Station	PS	PS 139
Pump Station	PS	PS 145
Pump Station	PS	PS 092
Pump Station	PS	PS 108
Pump Station	PS	PS 149
Pump Station	PS	PS 159
Pump Station	PS	PS 161
Pump Station	PS	PS 163
Pump Station	PS	PS 154
Pump Station	PS	PS 054

Name	Code	Number
Pump Station	PS	PS 056
Pump Station	PS	PS 057
Pump Station	PS	PS 060
Pump Station	PS	PS 063
Pump Station	PS	PS 066
Pump Station	PS	PS 067
Pump Station	PS	PS 068
Pump Station	PS	PS 071
Pump Station	PS	PS 072
Pump Station	PS	PS 074
Pump Station	PS	PS 075
Pump Station	PS	PS 077
Pump Station	PS	PS 078
Pump Station	PS	PS 080
Pump Station	PS	PS 001
Pump Station	PS	PS 002
Pump Station	PS	PS 003
Pump Station	PS	PS 005
Pump Station	PS	PS 006
Pump Station	PS	PS 007
Pump Station	PS	PS 008
Pump Station	PS	PS 013

Source: AMEC
Critical Facility Key Code, see Appendix E

Table 5.2.5e-Critical Facilities at Risk - High Wildfire Hazard Zone

Name	Code	Number
Pump Station	PS	PS 030
Pump Station	PS	PS 031
Station 5	FR	2
Station 4	FR	5
Fire Training Center	FR	15
Woodside Hospital	HO	6
Pump Station	PS	PS 117
Pump Station	PS	PS 139
Pump Station	PS	PS 152
Pump Station	PS	PS 165
Pump Station	PS	PS 057
Pump Station	PS	PS 069
Pump Station	PS	PS 075

Source: AMEC
Critical Facility Key Code, see Appendix E

5.2.6 Capability Assessment – City of Newport News

As an additional tool to assist with the examination of the hazards identified and to evaluate the community's ability to plan, develop, and implement hazard mitigation activities, the planning team developed a local capability assessment for the City of Newport News. This assessment is designed to highlight both the codified, regulatory tools available to the community to assist with natural hazard mitigation as well as other community assets that may help facilitate the planning and implementation of natural hazard mitigation over time. The following Capability Assessment Matrix was used as a basis for the City of Newport News' mitigation plan.

Table 5.2.6 - Capability Matrix – City of Newport News

	City of Newport News
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	Yes
-Effective Flood Insurance Rate Map Date	1-17-86
-Substantial Damage Language	Yes
-Certified Floodplain Manager	No
-Number of Floodprone Buildings	4,596
-Number of NFIP policies	1,741 (38%) as of 6/04
-Maintain Elevation Certificates	Yes
-Number of Repetitive Losses	20

	City of Newport News
CRS Rating	None
Stormwater Program	Yes
Building Code Version Full-time Building Official	VUSBC (IBC 2003) Yes
- Conduct "As-built" Inspections	Yes
- BCEGS Rating	3
Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes
-Storm Ready Certified	Yes
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	Yes, for Surry only
-Emergency Notification (R-911)	Yes
-other (e.g., cable override)	Yes, cable-override
GIS system	Yes
-Hazard Data	Yes
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	Yes
Property Owner Protection Projects	Yes
Critical Facilities Protected	Not fully
Natural Resources Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

Form of Governance

A Council-Manager form of government in which seven persons are elected to serve on City Council manages Newport News. Two members are elected from each of three districts, and the mayor is elected at-large. The City Manager is appointed by the City Council. The City Council also appoints the City Attorney and the City Clerk.

Guiding Community Documents

The City of Newport News has a range of guidance documents and plans for each of their departments. These include a comprehensive plan, a Flood Protection Plan, and emergency management plans. The City uses building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the municipality guides its' future is through policies laid out in the comprehensive plan, entitled *Framework for the Future*.

<u>Framework for the Future (2000)</u>
The Code of Virginia requires all cities and counties in the state to have a comprehensive plan and to review it every five years to determine if revisions are necessary. The City of Newport News' *Framework for the Future* features the following:

- The plan presents long-range intentions regarding the direction and nature of future development, assesses current conditions and incorporates citizen desires into long-range public policy.
- Comprised of twelve elements that focus on aspects of future development: economic development, land use, transportation, education, parks and recreation, housing, public safety, historic preservation, human services, culture, environment, and urban services.
- Environmental element concentrates on air quality, wetlands, floodplains, natural heritage areas, soils, and water quality.
- Plans for continued growth and development and urban design in designated growth/redevelopment areas, including:
  - Oyster Point/Port Warwick
  - Patrick Henry Mall area, south of the airport
  - Endview Plantation
  - Lee Hall Industrial Park

The *Framework for the Future* also contains a *Chesapeake Bay Technical Support Document* addendum which further discusses physical constraints to development in the city: protection of potable water supply; shoreline erosion control; public and private access to the waterfront; and redevelopment of intensely developed areas and other areas targeted for redevelopment.

<u>Zoning & Development Standards</u>

- Identifies existing federal and state regulations for wetland, floodplain, and RPA/RMA protection.
- The document outlines required standards for new development and redevelopment based on use and zoning designation.

The City of Newport News has exceeded the minimum requirements of the NFIP through adoption of their floodplain management ordinance. The floodplain is designated as an Overlay Zoning District in Zoning Ordinance, Article XXXI, Section 45, Division 2. The community has 20 repetitive losses through the NFIP, three of which were constructed after the community's flood hazard areas were mapped (post-FIRM). The City conducted a post-flood analysis after Hurricane Floyd and concluded that one foot of freeboard would be mandated for floodplain structures. The ordinance was amended to incorporate one foot of freeboard for structures, and two feet of freeboard above the BFE for storage of certain chemicals. The freeboard also applies to structures built in the Coastal High Hazard Area. The City's Building Permit application includes a notation regarding the map panel and zone designation, and a space for the Finished Floor Elevation.

A Site Plan Review Committee for new commercial and multi-family development projects is made up of representatives from Fire and Police Departments, Newport News Waterworks, Department of Public Works, Department of Economic Development, Planning, and Codes Compliance. The Engineering Department sends at least three representatives to deal with traffic, stormwater, and storm sewer issues. Emergency Management is not involved in the Site Plan Review Committee. The City has been considering the USACE's desire to be included in the early stages of site plan review.

Building Codes

The Commonwealth of Virginia is responsible for enacting the Virginia Uniform Statewide Building Code (VUSBC), and the City of Newport News is responsible for enforcing the code locally. As of January of 2005, the VUSBC is based on the 2000 International Building Code, International Plumbing Code, International Mechanical Code, and International Fire Protection Code, and the 1999 National Electrical Code. The 2003 version of the IBC has been incorporated into the VUSBC, and went into effect in April 2005. The code contains the building regulations that must be complied with when constructing a new building or structure or an addition to an existing building, maintaining or repairing an existing building, or renovating or changing the use of a building or structure.

Enforcement of the VUSBC is the responsibility of the local government's building inspections department. Newport News charges fees to defray the costs of enforcement and appeals arising from the application of the code. The VUSBC contains enforcement procedures that must be used by the enforcing agency.

As provided in the Uniform Statewide Building Code Law, Chapter 6 (36-97 et seq.) of Title 36 of the Code of Virginia, the USBC supersedes the building codes and regulations of the counties, municipalities and other political subdivisions and state agencies, related to any construction, reconstruction, alterations, conversion, repair or use of buildings and installation of equipment therein. The USBC does not supersede zoning ordinances or other land use controls that do not affect the manner of construction or materials to be used in the construction, alteration, or repair.

Flood Protection Plan

The *Flood Protection Plan* was developed in 1999 as part of a review of stormwater management program elements in order to receive Flood Mitigation Assistance funding and as a future NFIP Community Rating System program element. The plan details the City's floodplain management activities, including (re)development regulations, capital projects, maintenance and education/outreach. New initiatives from the plan included development of flood reduction strategies for the Salter's Creek and Newmarket Creek floodplains.

Stormwater Program and Fees

In 1993, the City implemented a Stormwater Management Service Charge to fund a comprehensive stormwater management program, including capital project funding. Consequently, stormwater management capital project funding does not compete with other project funding such as that for schools and public buildings. Within the Salter's Creek and Newmarket Creek drainage basins, a *Master Drainage and Flood Control Plan* identified major capital projects to address flooding associated with the conveyance system. Implementation of these projects is ongoing and continues as funding becomes available.

Maintenance of the City's stormwater conveyance system is a priority element of the Comprehensive Stormwater Management Program and Flood Protection Plan. Major outfall ditches are on regular maintenance intervals generated by an automated work order system. Roadside, back and side lot ditch maintenance is done on a manual, preventive maintenance schedule.

Stormwater program employees are available to assist property owners with shoreline erosion problems. The engineers can conduct on-site inspections and provide recommendations, and may also act as a liaison with the State's Shoreline Erosion Advisory Service. The City's Department of Planning and Department of Development distributes a brochure on shoreline erosion that includes recommended measures and examples of poor shoreline management.

Public Education

Among the readily available public outreach mechanisms for the City of Newport News, the City's website (http://www2.ci.newport-news.va.us/newport-news/index.htm) provides residents with pertinent information, provides on-line complaint forms, real estate information site, and answers numerous Frequently Asked Questions (FAQs). The City also posts most of its guiding documents, including the Comprehensive Plan on this site.

The City has implemented a program to educate citizens about floodplain management issues. Direct mailings, community meetings and newspaper advertisements are used to inform citizens about the NFIP and the Flood Assistance Program (see below). The City has also provided at least two of its five libraries with references on floodplain management and flood insurance.

Public educational advisories, public forums and brochure distribution addressing preparedness issues are conducted on an ongoing basis. The City uses presentations at booths, fairs, special needs meetings, and neighborhood group meetings to promote family preparedness and public awareness of shelter locations and evacuation routes.

Emergency Preparedness

Emergency Alert System (EAS) is a national civil emergency alert system that uses message relays between member radio and television stations to inform the public about immediate threats to national security, life, and property. EAS is now routinely used for severe weather warnings and can also be employed to disseminate Amber Alerts for missing children. The enhancement is an initiative of Governor Warner's Secure Virginia Panel designed to improve statewide preparedness, response, and recovery capabilities for emergencies and disasters. Governor Mark R. Warner announced on June 5, 2004, that Virginia would enhance its public warning capabilities with a new satellite-based system that can rapidly transmit EAS messages throughout the Commonwealth. Newport News is adding a radio station that will broadcast Newport News information only.

Storm Ready – Newport News was one of the first five communities in Virginia to be "Storm Ready." Storm Ready is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle severe weather. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations. To be officially Storm Ready, a community must:

- Establish a 24-hour warning point and emergency operations center,
- Have more than one way to receive severe weather warnings and forecasts and to alert the public,
- Create a system that monitors weather conditions locally,
- Promote the importance of public readiness through community seminars, and
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

Newport News uses Dialogic to manage the City's database of special needs residents. The program allows emergency managers to contact these residents directly in the event of an emergency. A special disaster hotline is activated during disasters, and all residents can call 269-2910 for assistance during events. The Office of Emergency Management has set up a special volunteer Emergency Information Team to supplement regular emergency management staff during disaster events.

Following Hurricanes Isabel and Floyd, the City made special arrangements with nursing homes, other special needs facilities, and Dominion Power to facilitate priority power restoration at these structures. A special needs shelter was established during Hurricane Isabel. In addition, the City Jail and Riverside Hospital have emergency power generators. Riverside Hospital has instituted new security procedures to prevent use of hospital power by area residents who needed to charge cell phones and conduct other non-emergency business after Hurricane Isabel.

Other Mitigation Activities

Flood Assistance Program (FAP) – FAP is a voluntary program that offers flood assistance to owners of structures that are located in the 100-year floodplain, that have finished flood elevations below the BFE and for which construction began prior to December 31, 1974 (pre-FIRM), regardless of the owner's insurance status. There are three types of assistance considered by the program: structure and property acquisition; structure elevation; and structure relocation. Based on a cost-benefit analysis, the City determines which assistance alternative is the most appropriate for each individual site. The program is administered and funded through the City's Department of Engineering, and administrative guidelines for the assistance are in place. As of January 2005, the City has purchased approximately 30 structures and/or parcels through FAP and dedicated the newly acquired land to open space use in perpetuity. The program began in response to flooding associated with Hurricane Floyd. The City has independently completed first floor elevation surveys of all structures in the Salter's Creek and

Newmarket Creek floodplains, and the FAP efforts have been focused in these areas due to chronic flooding. The City has also used some stormwater utility funds to purchase homes in these areas.

In November of 1969, the USACE in cooperation with the Cities of Newport News and Hampton completed a local flood control project on Newmarket Creek north of Mercury Boulevard. The project improved the Newmarket Creek channel from Dresden Drive to Mercury Boulevard, where a dam was constructed to divert floodwaters from Newmarket Creek into Government Ditch. In the 1980s, the City of Newport News extended the Newmarket Creek Improvement project north from Dresden Drive to J. Clyde Morris Boulevard. The City's channelization project confined the 100-year flood to the newly constructed channel cross-section. These projects significantly reduced the frequency of flooding between Mercury Boulevard and J. Clyde Morris Boulevard.

Green Foundation – The Newport News Green Foundation works with residents and landowners to preserve and establish green areas in the city. The program is administered through the Department of Development. Priority acquisitions include remnant parcels with trees, along major arterials. City planning officials note that this program assists with preservation of open space, and could be used as a mitigation tool to address future land use of flood-prone, acquired parcels.

Newport News has 170 sanitary sewer pumping stations throughout the city. Officials applied for post-Isabel mitigation funding to elevate six of the repetitively-flooded stations. Federal-funding was denied; however, the City has decided the project must go forward and has included it in the budget for the coming year.

The City's EOC was originally located in the basement of City Hall, in the eastern end of Newport News. Due to flooding concerns, a new EOC compound was constructed in the Oyster Point area. The windows of the new EOC are hurricane-proof (Category 2 storm), and the building complex has its own regularly-tested power generator back-up system. Following Hurricane Isabel and the receipt of updated storm surge mapping, several of the city emergency shelters have been taken off the list. The new list of primary and secondary shelters does not include any flood-prone structures, and the City is making arrangements to ensure that residents in the southeast community (flood-prone) part of the city are bused to shelters in the northern section. Primary shelters are built to resist Category 2 storms.

5.3 City of Williamsburg Profile

The following sections present a detailed assessment of critical hazards that affect the City of Williamsburg. Understanding these hazards will assist the Peninsula region in its process of identifying specific risks and developing a mitigation strategy to address those risks.

5.3.1 Flooding – City of Williamsburg

As part of the NFIP, FEMA has created a Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for the City of Williamsburg. In addition, the NCDC tracks the occurrence of flooding events for communities across the nation. These data sources and others were utilized in developing the hazard identification and vulnerability assessment.

The FIS for the City of Williamsburg was published March 2, 1994. The FIRMs, which accompany this FIS, delineate the 100- and 500-year flood hazard boundaries for flooding sources identified in areas of growing development or areas predicted to have future development, at the time of the report. A detailed study was conducted in order to delineate the 100- and 500-year flood hazard boundaries for the City. This analysis resulted in a 100-year stillwater elevation of 8.5 feet for most of the City. The significant flood events outlined in the FIS are given below in Table 5.3.1a, although specific reference to flooding or damage in Williamsburg in the FIS is scarce.

Table 5.3.1a -Significant Flood Events – City of Williamsburg

Date	Storm	Tide Elevations
August 1933	Hurricane	Max tide heights averaged 8 feet
April 1956	Nor'easter	Not given
October 1957	Hurricane – Not Named	Not given
September 1960	Hurricane Donna	Not given
March 1962	Nor'easter	Max tide heights averaged 6.8 feet

Source: FEMA 1994

The NCDC, operated by NOAA, also keeps a record of significant weather related events and damage estimates for the entire country. Listed below (Table 5.3.1b) is the significant event that affected the City of Williamsburg.

Table 5.3.1b- NCDC Listed Significant Flood Event –City of Williamsburg

Date	Event	Precipitation	Comments
September 15 to 17, 1999	Hurricane Floyd	12 to 18 inches	▪ Road flooding and landslides

Community officials indicate that there have been two additional and significant flood events in Williamsburg that were not included in the FIS or the NCDC databases. In June 1963, excessively heavy rains caused the original Waller Mill Dam to break, damaging homes and infrastructure in Williamsburg. The 270-foot dam was rebuilt, and currently retains a 343-acre reservoir. The second flood event occurred on August 18, 1989 when a remarkable rain cell unloaded 12 inches of precipitation on the City, flooding City Hall.

5.3.2 Hurricanes – City of Williamsburg

The FIS for the City of Williamsburg identified three historic hurricanes that affected the City (see Table 5.3.1a above); however, specific damage details are not provided. The NCDC dataset listed seven hurricanes for the City of Williamsburg for the period 1950 to June 2004. These storms are listed in Table 5.3.2. An obvious disconnect between the data sources is evident. The NCDC database covers the past 50 years, but only cites storms since 1995 and omits major hurricanes, such as Donna (1960), which are cited in the FIS.

Hurricane Floyd moved through the area dropping several inches of rain within 24 hours and generating winds in excess of 40 mph. Lower James City County reported 12.83 total inches of rain for the storm. In Williamsburg, the primary damage was from road flooding and landslides.

Hurricane Isabel made landfall on September 18, 2003 as a Category 2 hurricane near Drum Inlet, North Carolina. Hurricane Isabel is considered to be one of the most significant tropical cyclones to hit this area since Hurricane Hazel (1954) and the Chesapeake-Potomac hurricane of 1933 (Hazel is not included on either the NCDC or FIS data sets, but has been identified locally by the PHMPC). Isabel produced storm surges six to eight feet above normal high tide levels and is directly responsible for 10 deaths in Virginia and indirectly responsible for 22 deaths. Isabel caused wide spread wind and storm surge damage in eastern North Carolina and southeastern Virginia, currently estimated at $925 million in Virginia. All of the above data was taken from the NOAA Tropical Cyclone Report for Hurricane Isabel (Beven and Cobb, 2004).

During the 2004 hurricane season, five separate tropical cyclones (Charley, Frances, Ivan, Jeanne, and Gaston) of varying magnitude hit the eastern and Gulf coasts of the United States. Although the damage from these storms to the Peninsula region was minor, the occurrence of significant multiple events over a few weeks highlights the vulnerability of the planning area to these storms, and infers the disruption that they create (Table 5.3.2).

Table 5.3.2- Historic Hurricanes – City of Williamsburg

Date	Storm Name	Category	Descriptions
August 15, 1995	Felix	Not given	▪ No major damage reported in VA ▪ Tides 2.0-2.5 feet above normal
July 12, 1996	Hurricane	Not Given	▪ None given
September 1, 1999	Dennis	Hurricane/Tropical Storm	▪ Prolonged period of tropical cyclone ▪ Generated a F2 tornado ▪ Tide 3 feet above normal ▪ Coastal flooding ▪ 2 to 5 inches of rain ▪ $27,000 damage
September 15, 1999	Hurricane Floyd	Category 1	▪ Spawned 2 tornados ▪ Hundreds of downed tress ▪ Tide 3.9 feet above normal ▪ Numerous roads washed out ▪ $99.4 million in property damage over the entire affected area
September 18, 2003	Hurricane Isabel	Category 1/Tropical Storm	▪ Hundreds of downed tress ▪ Loss of power ▪ Damaged residents and businesses ▪ Greatest storm surge since Hazel
August 18, 2004	Charley	Hurricane	▪ Highest sustained wind was 73 mph ▪ Uprooted of trees and downed numerous power lines ▪ Over 2 million Virginians without power ▪ Heavy rain and wind gust
September 8, 2004	Frances	Hurricane	▪ Generated 9 tornados in Central Virginia ▪ High winds ▪ Large amounts of rainfall/flooding
September 17, 2004	Ivan	Hurricane	▪ Spawned unconfirmed tornados ▪ Power outage (66,000) ▪ Heavy rain/flooding
September 28, 2004	Jeanne	Hurricane	▪ Flash flooding/heavy rainfall ▪ Power outage
August 30, 2004	Gaston	Tropical Depression	▪ Hard rains that processed flooding ▪ Roads under water ▪ Power outage (99,600 statewide)

5.3.3 Tornados – City of Williamsburg

The City of Williamsburg has experienced three recorded tornados between 1896 to 1999 (Table 5.3.3) that caused damage. The most significant tornado occurred on October 14, 1986, which generated wind of 110 mph and caused $1.8 million in damages the entire affected area.

Table 5.3.3- Historic Tornados – City of Williamsburg

Date	Magnitude	Deaths	Injuries	Descriptions
July 8, 1896	Not Given	Not Given	2-5	▪ Spawned by a hurricane ▪ Barns and small houses destroyed
May 8, 1984	Not Given	Not Given	Not Given	▪ Spawned by sever thunderstorms ▪ Destroyed three mobile homes
October 14, 1986	F2	Not Given	Not Given	▪ Downburst of 110mph ▪ Damages of $1.8 million over entire affected area

5.3.4 Wildfire – City of Williamsburg

Many wildfires are caused by human acts, either intentional, such as arson or unintentionally. They can also be started by natural occurrences, such as lightning strikes. Wildfire danger can vary greatly from season to season and is often exacerbated by dry weather conditions. Because of wildfire risk, VDOF has produced Fire Risk Assessment Maps designed to help communities determine areas with the greatest vulnerability to wildfire.

The Wildfire Risk Assessment Map, Appendix B, delineates the aerial extent of wildfire vulnerability within the City of Williamsburg. Approximately 55 percent of the city is in a high wildfire risk area. Parameters used to establish these risk boundaries are land use, population density, slope, land cover and proximity to roads. The proximity of the tree lines or brush to the highway or roadway is also included in the wildfire risk analysis to capture the human/wildfire causal relationship. Travel corridors increase the probability of human presence, thereby increasing the probability of wildfire ignition. Thus, areas closer to roads are much more likely to attain a higher ignition probability.

Parts of the Peninsula region near Williamsburg are experiencing an accelerated development rate. Land that once was rural and relatively inaccessible is now either under development or planned for development. Although the clearing of land for development removes potential fuel sources for wildfire, the wildfire hazard is not necessarily diminished because human access to the area is significantly increased. This development trend expands the wildland/urban interface, by placing structures in close proximity to large amounts of vegetation, which in turn increases the risk of wildfire (NWUIFPP undated).

5.3.5 Vulnerability Assessment – City of Williamsburg

The PHMPC conducted a vulnerability analysis for each critical hazard that was identified as having a medium to high hazard potential of occurrence. As several of these hazards are prone to occur in any part of the city, the exposure associated with tornados and winter storms is assumed to include the entire city. This section describes the method used to perform the vulnerability analysis for each hazard and then lists the results.

Flooding – City of Williamsburg
The City's GIS consultant provided a building layer, which was overlaid with the City of Williamsburg FIRM. The two maps were compared to determine the number of buildings in the 100-year floodplain, as the results determined that no buildings were located within the 100-year floodplain of Williamsburg.

FEMA has developed a concept to highlight the impact that repetitively flooded structures have had on the NFIP. The term "repetitive loss," as applied to the NFIP, refers to any property for which two or more flood insurance claims in excess of $1,000 each in a 10-year period of time have been paid. Including flood insurance claims paid as a result of flood damage caused by Hurricane Isabel in 2003, FEMA has identified no (zero) repetitive loss structures in the City of Williamsburg.

Hurricane – City of Williamsburg

Hazards U.S. – Multi Hazard (HAZUS®*MH*) was utilized to perform a wind hazard analysis for the entire Peninsula region. HAZUS®*MH* software is a multi-hazard loss estimation program that was developed under a cooperative agreement between the National Institute of Building Sciences and FEMA. The current version of HAZUS®*MH* has the ability to calculate earthquake, wind, and flood hazards as well as potential economic losses associated with these hazards. The software is designed with the flexibility to perform loss estimations at three different levels. Level 1 utilizes all default parameters built into the software. Levels 2 and 3 require user defined scenarios and building inventory data. For the purpose of this Plan, a Level 1 wind analysis was performed to calculate the wind hazard for each Peninsula community. The probabilistic scenario activates a database of many thousands of storm tracks and intensities. This scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year.

Table 5.3.5a lists the total dollar value of exposed structures for the City of Williamsburg to wind damage based on the 2002 Census data.

Table 5.3.5a- Value of Exposed Structures from HAZUS®*MH* – City of Williamsburg

Occupancy Type	Value of Exposed Structures ($1,000)
Residential	727,908
Non-Residential	229,073
Total	**956,981**

The probabilistic analysis generated with the HAZUS®*MH* software utilized the same building stock information listed above for the 1933 historic hurricane. The probabilistic scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year. The probabilistic method was used to generate loss estimations of storms with specific recurrence intervals: 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year. Since residential structures comprised a significantly large percentage of the occupancy classification these data are presented in Table 5.3.5b below.

Table 5.3.5b- Summary of Hurricane Probabilistic Analysis on Residential Structures – Williamsburg

Return Period	Residential Building Damage – Number of Buildings			
	Minor	Moderate	Severe	Destruction
10-year	5	0	0	0
20-year	21	1	0	0
50-year	106	9	1	0
100-year	17	1	0	0
200-year	719	255	14	5
500-year	922	712	98	46
1000-year	897	822	148	69

Tornado – City of Williamsburg

The facilities and building stock that were identified as exposed under hurricane hazards are also exposed to tornado hazards. Tornados are random natural events that strike with little warning but are associated with thunderstorms and hurricanes. No damage estimates have been created for tornados that might strike Williamsburg.

Wildfire – City of Williamsburg

The Wildfire Risk Assessment data, provided by the Virginia Department of Forestry, was used as a starting point to estimate the wildfire risk for the City of Williamsburg. This data layer was revised by City staff and incorporated into the all-hazard map (Appendix F). This data layer was overlaid with the City's tax parcel mapping in order to estimate the value of at risk structures. The VDOF also provided the number of wildfire incidence reported from 1995-2001.

According to the VDOF, no wildfires were reported in Williamsburg between 1995-2001. City staff provided the value of residential and commercial parcels that are at risk to wildfire. The values are based on the improvement values for residential and commercial parcels that intersect the high wildfire hazard areas. The analysis resulted in an at-risk value of $14,582,700 for residential properties and $9,304,700 for commercial properties.

Critical Facilities

The PHMPC also conducted an inventory of Williamsburg critical facilities (Appendix E). Critical facilities are those facilities that warrant special attention in preparing for a disaster and/or facilities that are of vital importance to maintaining citizen life, health, and safety during and/or directly after a disaster event. The inventory of critical facilities for the City of Williamsburg includes emergency response facilities such as police stations, fire departments, emergency medical service stations (EMS), public facilities including schools and local government buildings (Table 5.3.5c). Those critical facilities that are geographically located within an identified hazard zone are listed below.

Table 5.3.5c-Critical Facilities at Risk – High Wildfire Hazard Zone

Name	Code	Number
Pump Station	PS	534
Pump Station	PS	536
Pump Station	PS	532

Source: AMEC
Critical Facility Key Code, see Appendix E

5.3.6 Capability Assessment – City of Williamsburg

As an additional tool to assist with the examination of the hazards identified and to evaluate the community's ability to plan, develop, and implement hazard mitigation activities, the planning team developed a local capability assessment for the City of Williamsburg. This assessment is designed to highlight both the codified, regulatory tools available to the community to assist with natural hazard mitigation as well as other community assets that may help facilitate the planning and implementation of natural hazard mitigation over time. The following Capability Assessment Matrix was used as a basis for the City of Williamsburg's mitigation plan.

Table 5.3.6 - Capability Matrix – City of Williamsburg

	City of Williamsburg
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	No – using Chesapeake Bay Preservation ordinance
-Effective Flood Insurance Rate Map Date	3-2-94
-Substantial Damage Language	No
-Certified Floodplain Manager	No
-Number of Floodprone Buildings	0
-Number of NFIP policies	29, as of 12/03
-Maintain Elevation Certificates	No
-Number of Repetitive Losses	0
CRS Rating	None
Stormwater Program	Yes
Building Code Version Full-time Building Official	VUSBC (IBC 2003) Yes
- Conduct "As-built" Inspections	Yes
- BCEGS Rating	2

	City of Williamsburg
Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes
-Storm Ready Certified	No
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	Yes, just for Surry
-Emergency Notification (R-911)	No
-other (e.g., cable override)	Text alerts in public bldgs (w/James City County)
GIS system	under development
-Hazard Data	under development
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	under development
Structural Protection Projects	Yes
Property Owner Protection Projects	Yes
Critical Facilities Protected	Not fully
Natural Resources Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

One highlight from the matrix is the existence of 29 NFIP policies, when there are no buildings within the 100-year floodplain. This suggests the City may be unaware of flooding or drainage issues.

Form of Governance

The Williamsburg City Council is composed of five members, elected at-large. The Council appoints the Mayor, Vice Mayor, City Manager, City Attorney and Clerk of Council. The Mayor chairs the City Council and acts as the official head of the City government. The City Manager administers the City government, carrying out the policies of City Council. The Council members serve four-year staggered terms, with elections held in May in even-numbered years.

Guiding Community Documents

The City of Williamsburg has a range of guidance documents and plans for each of their departments. These include a comprehensive plan and emergency management plans. The City uses building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the municipality guides its future is through policies laid out in the Comprehensive Plan.

Comprehensive Plan

The Code of Virginia requires all cities and counties in the state to have a comprehensive plan and to review it every five years to determine if it needs to be revised. The *1998 Comprehensive Plan* is the City's fifth plan, and will be updated in 2005. Although the *1953 Comprehensive Plan* was the first formal plan adopted under State law, the City's first plan in 1633 encouraged a new settlement at Middle Plantation with high ground, better drainage, good water and more central to the growing colony, out of the range of a ship's guns and less vulnerable to mosquitoes. The modern-day document features the following:

- The plan presents long-range intentions regarding the direction and nature of future development.
- Plan goals are grouped into seven general categories: environment, transportation, housing, land use, public services, economic development and implementation.
- Geographically, the plan is divided into 10 planning areas: Capitol Landing, Center City, Colonial Williamsburg, Courthouse, Midtown, Patriot, Richmond Road, Strawberry Plains, Wales, and the Entrance Corridors.
- The Open Space and Recreation element focuses on planned improvements to both active and passive parks at Capitol Landing, College Creek, Papermill Creek, Merrimac Trail, Quarterpath Park, Berkeley Park, and Waller Mill Park.
- Plans for continued growth and development and urban design in designated growth/redevelopment areas, including:
    - Riverside Hospital property holdings
    - High Street
- Plans for necessary transportation enhancements and improvements to service projected growth.

As a result of recommendations in the *1989 Comprehensive Plan*, a Listing of Significant Architecture and Areas in Williamsburg was created. The database is based on the results of a 1992 Architectural Survey. An Architectural Review Board (ARB) reviews development proposals for listed properties or properties in the vicinity of the Architectural Preservation District and Corridor Protection Districts. Design Review Guidelines transcribe the design review and community preservation goals used by the ARB. The latest Comprehensive Plan designates 301 acres as "museum support", or areas that are part of Colonial Williamsburg or the historic campus of the College of William and Mary. Colonial Williamsburg maintains a database with 88 of the historic structures within their preview.

Zoning & Development Standards

- Identifies existing federal and state regulations for wetland and RPA/RMA protection.
- The document outlines required standards for new development and redevelopment based on use and zoning designation.

FEMA Region III has determined that the City of Williamsburg has adopted the minimum requirements of the NFIP through adoption of their Chesapeake Bay Preservation Ordinance at Article VIII of the Zoning Ordinance. Williamsburg has adopted stringent RPA and RMA zones with 100 feet and 500 feet buffers, respectively. The ordinance does not address new structural requirements (e.g., lowest floor elevation) and exempts remodeling or alterations to nonconforming principal structures, public utilities, railroads and other infrastructure, including water wells.

The FIRM indicates limited non-tidal floodplains exist along College Creek, Papermill Creek, Tutter's Neck Pond, and Queen Creek. The City's plan review, land disturbance and building permit applications do not contain any reference to flood hazards; however, the *Site Plan Checklist* mandates delineation of floodplain limits on the site plans.

A Technical Review Committee for new development is made up of representatives from Codes Compliance, Fire, Police, Public Works, and Planning.

Stormwater Program

Oversight for the City's drainage system is provided by the Department of Public Works, Engineering Division. Engineering staff review site and subdivision plans to ensure compliance with the City's ordinances, provide project management for the City's capital improvement program, and provide quality control on construction of public improvements. Site plans for large developments are required to incorporate a stormwater fee or stormwater utility to ensure long-term maintenance of the drainage improvements. The Department has assisted with installation of BMPs for several chronically-flooded intersections. Engineers are also available to assist citizens with questions on all aspects of Public Works and Utilities.

Public Education

Among the readily available public outreach mechanisms for the City of Williamsburg, the City's website (http://www.ci.williamsburg.va.us/index.htm) provides residents with pertinent information, a property information tool, and answers to numerous Frequently Asked Questions. The City also posts most of its guiding documents, including the Comprehensive Plan.

The Fire and Police Departments conduct numerous types of public outreach regarding crime and fire prevention, including a program for fourth-grade students regarding fire and all-hazard safety. The Emergency Preparedness web site contains sections promoting family disaster preparedness, and a Neighborhood Guide with action plans and other valuable information for Williamsburg's residents and visitors. City Hall maintains a display of pertinent brochures and disaster-related handouts.

Emergency Preparedness

Emergency Alert System (EAS) is a national civil emergency alert system that uses message relays between member radio and television stations to inform the public about immediate threats to national security, life, and property. EAS is now routinely used for severe weather warnings and can also be employed to disseminate Amber Alerts for missing children. The enhancement is an initiative of Governor Warner's Secure Virginia Panel designed to improve statewide preparedness, response, and recovery capabilities for emergencies and disasters. Governor Mark R. Warner announced June 5, 2004, that Virginia will enhance its public warning capabilities with a new satellite-based system that can rapidly transmit EAS messages throughout the Commonwealth. WMBG 740AM provides public notifications for Williamsburg.

Community Emergency Response Teams – By summer 2006, the City plans to recruit, train, and deploy functioning Neighborhood Response Teams, trained through the Citizen Corps/CERT process, to assist with government response of natural and manmade disasters and emergencies. CERT helps communities respond to disasters during the first 72 hours following a disaster when flooded roads, disrupted communications, and emergency demand outweigh local emergency services. The purpose of CERT training is to provide private citizens with basic skills to handle virtually all of their own needs and then to respond to their community's needs in the aftermath of a disaster.

Other Mitigation Activities

Numerous best management practices (BMPs) have been implemented to alleviate chronic flooding in key intersections, including a redesigned drainage system along Richmond Road with larger culverts, and improved drainage at the Yankee Candle Factory. A dam break in 1988 resulted in a pond redesign within the City. Several private property owners have addressed problems with erosion control and mudslides on steep slopes, especially following the heavy precipitation associated with Hurricane Floyd.

Critical facility protection has been addressed through a Homeland Security Assessment, which notes the importance of Williamsburg as home to the "ideas of democracy." Electronic card access for the EOC was added to increase security during disasters and terror alerts. The reservoir and pump station were recently fenced. A mobile command unit for the EOC has been arranged to provide backup in the case of an event in central Williamsburg. The City's Property Information System is now backed up and maintained by a remote vendor with power backup. During and after Hurricane Isabel when power was unavailable, City officials had no access to the system because the remote vendor did not have power. The City also maintains a database of critical road intersections and has developed a plan to provide power backup to those intersections as necessary. The City's filter plant now has power backup and all pump stations will soon have generator back-up. During power outages, volunteer Ham radio operators are invited to the EOC to assist with communications.

Many special needs residents are addressed in State-mandated emergency plans for nursing homes. Backup power plans are incorporated into the plans, and emergency management officials meet quarterly with hospital and nursing home representatives to address planning issues. Williamsburg has added hospital and nursing home representatives to the EOC.

In cooperation with James City County, Williamsburg is installing text alerts for severe weather in public buildings, including school and libraries. Large digital readout boxes are installed, generally above prominent doorways, and can be programmed to display a particular warning or message. Rather than sharing shelters with James City County as in previous disasters; Williamsburg is developing a new shelter plan for their residents.

5.4 James City County Profile

The following sections present a detailed assessment of critical hazards that affect James City County. Understanding these hazards will assist the Peninsula region in its process of identifying specific risks and developing a mitigation strategy to address those risks.

5.4.1 Flooding – James City County

Due to its geographic location, James City County is susceptible to tidal and non-tidal flooding. Storms associated with coastal flooding include tropical cyclones and nor'easters. These types of events typically drop large amounts of rain and generate high winds that result in storm surge and non-tidal flow resulting from upstream precipitation. Storm surge is the water that is pushed toward the shore by the persistent force of the winds of an approaching storm. Astronomical tides occur independent of climactic conditions. Depending on the tide level at the time a land-falling storm surge may be elevated. Flash flooding and urban flooding are also a concern within the County limits.

As part of the NFIP, FEMA has created a Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for James City County. In addition, the NCDC tracks the occurrence of flooding events for communities across the nation. All of these data sources were utilized in developing the hazard identification and vulnerability assessment.

FEMA published a FIS for James City County, dated February 6, 1991. The FIRMs, which accompany this FIS, delineate the 100- and 500-year flood hazard boundaries for flooding sources identified in areas of growing development or areas predicted to have future development, at the time of the report. A detailed wave height analysis was developed in order to delineate the 100- and 500 year flood hazard boundaries for the County. This analysis resulted in a 100-year stillwater elevation of 8.5 feet for the County and a maximum 100-year wave crest of 11 to 13 feet. Refer to this report for a detailed description of methods and assumptions. The significant flood events outlined in the FIS are given below in Table 5.4.1a.

Table 5.4.1a- Significant Flood Events – James City County

Date	Storm	Tide Elevations
August 1933	Hurricane	Max tide heights averaged 8 feet
April 1956	Nor'easter	Not given
October 1957	Hurricane – Not Named	Not given
September 1960	Hurricane Donna	Not given
March 1962	Nor'easter	Max tide heights averaged 6.8 feet

Source: FEMA 1991

The NCDC, operated by NOAA, keeps a record of significant weather related events and damage estimates for the entire country. Listed below (Table 5.4.1b) are the significant events that have affected James City County.

Table 5.4.1b- NCDC Listed Significant Flood Events –James City County

Date	Event	Precipitation	Comments
September 15 to 17, 1999	Hurricane Floyd	12 to 18 inches	▪ Numerous roads washed out due to flooding ▪ Flooding considered 500-year flood ▪ Enormous crop damage
July 19, 2000	Flash Flood	Not given	▪ Heavy rain caused flooding and road closures of Routes 30 and 60 near Toano

5.4.2 Hurricanes – James City County

The FIS for James City County identified three hurricanes and 2 nor'easters that affected the County (see Table 5.4.1a above); however, specific damage estimates were not given. The NCDC dataset listed five hurricanes for James City County for the period between 1950 to June 2004. These storms are listed in Table 5.4.2. As in all other Peninsula communities, there are clear gaps and overlaps in the available data.

Hurricane Floyd moved through the area dropping four to five inches of rain within 24 hours and generated winds in excess of 40 mph. Throughout the Peninsula, trees and power lines were knocked down and roads were flooded; over 5,500 homes were left without power.

Hurricane Isabel tree damage in James City County

Hurricane Isabel made landfall on September 18, 2003 as a Category 2 hurricane near Drum Inlet, North Carolina. Hurricane Isabel is considered to be one of the most significant tropical cyclones to hit this area since hurricane Hazel (1954) and the Chesapeake-Potomac Hurricane of 1933. Isabel produced storm surges 6 to 8 feet above normal high tide levels and is directly responsible for 10 deaths in Virginia and indirectly responsible for 22 deaths. Isabel caused widespread wind and storm surge damage in eastern North Carolina and southeastern Virginia, currently estimated at $925 million in Virginia. All of the above data was taken from the NOAA Tropical Cyclone Report for Hurricane Isabel (Beven and Cobb, 2004).

Table 5.4.2- Historic Hurricanes – James City County

Date	Storm Name	Category	Descriptions
August 15, 1995	Felix	Not given	▪ No major damage reported in VA ▪ Tides 2.0-2.5 feet above normal
July 12, 1996	Hurricane	Not Given	▪ None given
September 1, 1999	Dennis	Hurricane/Tropical Storm	▪ Prolonged period of tropical cyclone ▪ Highest sustained winds at Langley 52 mph ▪ Generated a F2 tornado ▪ Tide 3 feet above normal ▪ Coastal flooding ▪ 2 to 5 inches of rain ▪ $27,000 damage
September 15, 1999	Hurricane Floyd	Category 1	▪ Spawned 2 tornados ▪ Hundreds of downed tress ▪ Tide 3.9 feet above normal ▪ Numerous roads washed out ▪ $99.4 million in property damage over the entire affected area ▪ Dam failure near Scotland Ferry/Route 31- this led to houses being flooded
September 18, 2003	Hurricane Isabel	Category 1/Tropical storm	▪ Hundreds of downed tress ▪ Loss of power ▪ Damaged residents and businesses ▪ Greatest storm surge since Hazel
August 18, 2004	Charley	Hurricane	▪ Highest sustained wind was 73 mph ▪ Uprooted of trees and downed numerous power lines ▪ Over 2 million Virginians without power ▪ Heavy rain and wind gust
September 8, 2004	Frances	Hurricane	▪ Generated 9 tornados in Central Virginia ▪ High winds ▪ Large amounts of rainfall/flooding
September 17, 2004	Ivan	Hurricane	▪ Spawned unconfirmed tornados ▪ Power outage (66,000) ▪ Heavy rain/flooding
September 28, 2004	Jeanne	Hurricane	▪ Flash flooding/heavy rainfall ▪ Power outage
August 30, 2004	Gaston	Tropical Depression	▪ Hard rains that processed flooding ▪ Roads under water ▪ Power outage (99,600 statewide)

5.4.3 Tornados – James City County

James City County has experienced three tornados over the period of 1896 to 1999 (Table 5.4.3), which have caused a variety of damage. The most significant tornado occurred on October 14, 1986, which generated wind of 110 mph and cause $1.8 million in damages over the entire affected area.

Table 5.4.3-Historic Tornados – James City County

Date	Magnitude	Deaths	Injuries	Descriptions
July 8, 1896	Not Given	Not Given	2-5	▪ Spawned by a hurricane ▪ Barns and small houses destroy
May 8, 1984	Not Given	Not Given	Not Given	▪ Spawned by sever thunderstorms ▪ Destroyed three mobile homes
October 14, 1986	F2	Not Given	Not Given	▪ Downburst of 110mph ▪ Damages of $1.8 million over entire affected area

5.4.4 Wildfire – James City County

Wildfires are caused through human acts like arson or careless accidents, or through natural occurrences, such as lightning strikes. Wildfire danger can vary greatly season to season and is often exacerbated by dry weather conditions. Because of wildfire risk, VDOF has developed Fire Risk Assessment Maps designed to help communities determine areas with the greatest vulnerability.

The Wildfire Risk Assessment Map, Map C-3, delineates the aerial extent of wildfire vulnerability within James City County. Approximately 33 percent of the County lies within a high wildfire risk area. Parameters used to establish these risk boundaries are land use, population density, slope, land cover and proximity to roads. The proximity of the tree lines or brush to the highway or roadway is also included in the wildfire risk analysis to capture the human/wildfire causal relationship. Travel corridors increase the probability of human presence across a landscape, thereby increasing the probability of wildfire ignition. As such, areas closer to roads are much more likely to attain a higher ignition probability. James City County is currently experiencing an accelerated development rate. Land that once was rural and relatively inaccessible is now either under development or planned for development. Although the clearing of land for development removes potential fuel sources for wildfire, the wildfire hazard is not necessarily diminished because human access to the area is significantly increased. This development trend expands the wildland/urban interface, which place structures in close proximity to large amounts of vegetation, which in turn increases the risk of wildfire (NWUIFPP undated).

5.4.5 Vulnerability Assessment – James City County

The PHMPC conducted a vulnerability analysis for each critical hazard that was identified. As several of these hazards are prone to occur in any part of the County, the exposure associated with tornados and winter storms is assumed to include the entire County. This section describes the method used to perform the vulnerability analysis for each hazard and then lists the results.

Flooding – James City County

The County provided a flood layer, a tax parcel layer, and a tax assessor database. These layers were overlaid to determine the number of parcels that intersect the 100-year floodplain. The tax assessor database was used to determine the improvement values of these properties.

The analysis showed that there are 2,133 parcels that intersect the 100-year floodplain. These parcels have an improvement value of $979,665,400.

FEMA has developed a concept to highlight the impact that repetitively flooded structures have had on the NFIP. The term "repetitive loss," as applied to the NFIP, refers to any property for which two or more flood insurance claims in excess of $1,000 each in a 10-year period of time have been paid. In 1998, FEMA reported that the NFIP's 75,000 repetitive loss properties have already cost $2.8 billion in flood insurance payments and numerous other flood prone properties continue to remain at high risk in the nation's floodplains. While these properties make up only one percent of the flood insurance policies currently in force, they account for 30 percent of the country's flood insurance claim payments. A report on repetitive loss structures completed by the National Wildlife Federation found that 20 percent of these structures are listed as being outside of the 100-year floodplain (Conrad et al. 1998).

Including flood insurance claims paid as a result of flood damage caused by Hurricane Isabel in 2003, FEMA has identified seven structures as repetitive loss structures in James City County.

Hurricane – James City County

Hazards U.S. – Multi Hazard (HAZUS$^{®MH}$) was utilized to perform a wind hazard analysis for the entire Peninsula region. HAZUS$^{®MH}$ software is a multi-hazard loss estimation program that was developed under a cooperative agreement between the National Institute of Building Sciences and FEMA. The current version of HAZUS$^{®MH}$ has the ability to calculate earthquake, wind, and flood hazards as well as potential economic losses associated with these hazards. The software is designed with the flexibility to perform loss estimations at three different levels. Level 1 utilizes all default parameters built into the software. Levels 2 and 3 require user defined scenarios and building inventory data. For the purpose of this Plan, a Level 1 wind analysis was performed to calculate the wind hazard for each Peninsula community. The probabilistic scenario activates a database of many thousands of storm tracks and intensities. This scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year.

Table 5.4.5a lists the total dollar value of exposed structures for James City County. The default data set provided with the HAZUS$^{®MH}$ software is based on the 2002 Census data. This analysis depicts the probability of occurrence and can generally be used estimate potential damages due to high winds.

Table 5.4.5a-Total dollar value of Exposed Structures from HAZUS$^{®MH}$ – James City County

Occupancy Type	Value of Exposed Structures ($1,000)
Residential	$3,111,100
Non-Residential	$740,910
Total	**$3,852,010**

The probabilistic analysis generated with the HAZUS$^{®MH}$ software utilized the same building stock information listed above. The probabilistic scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year. The probabilistic method was used to generate loss estimations of storms with specific recurrence intervals: 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year. Since residential structures comprised a significantly large percentage of the occupancy classification these data are presented in Table 5.4.5b below.

Table 5.4.5b-Summary of Probabilistic Analysis – Residential Structures – James City County

Return Period	Residential Building Damage – Number of Buildings			
	Minor	Moderate	Severe	Destruction
10-year	10	0	0	0
20-year	83	3	0	0
50-year	630	37	2	0
100-year	58	2	0	0
200-year	5,029	1,113	74	66
500-year	7,400	3,235	578	533
1000-year	7,442	3,554	735	700

Tornado Vulnerability – James City County

The facilities and building stock that were identified as exposed under hurricane hazards are also exposed to tornado hazards. Tornados are random natural events that strike with little warning but are associated with thunderstorms and hurricanes. No damage estimates have been created for tornados that might strike James City County.

Wildfire – James City County

The Wildfire Risk Assessment data, provided by the Virginia Department of Forestry, was utilized to estimate the wildfire risk for James City County. This data layer was overlaid with the County's tax parcel mapping in order to estimate the value of at risk structures. The VDOF also provided the number of wildfire incidences reported from 1995 to 2001.

According to the VDOF, no incidences of wildfire were reported for James City County from 1995 to 2001. Analysis of the County resulted in 13,678 parcels intersecting a high wildfire zone. These parcels have a total improvement value of $3,881,690,400.

Critical Facilities

In order to assess the vulnerability of a community to natural hazards, the PHMPC conducted an inventory of James City County structures and critical facilities (Appendix E). Critical facilities are those facilities that warrant special attention in preparing for a disaster and/or facilities that are of vital importance to maintaining citizen life, health, and safety during and/or directly after a disaster event. The inventory of critical facilities for James City County includes emergency response facilities such as police stations, fire departments, emergency medical service stations (EMS), public facilities including schools and local government buildings. Those facilities that are geographically located within an identified hazard zone are listed below (Table 5.4.5c).

Table 5.4.5c- Critical Facilities at Risk - High Wildfire Hazard Zone

Name	Code	Number
Fire Station 5	FR	3
Fire Station 3	FR	5
Law Enforcement Center	PO	1
Jamestown High School	SC	5
James River Elementary School	SC	13

Source: AMEC
Critical Facility Key Code, see Appendix E

5.4.6 Capability Assessment – James City County

As an additional tool to assist with the examination of the hazards identified and to evaluate the community's ability to plan, develop, and implement hazard mitigation activities, the planning team developed a local capability assessment for James City County. This assessment is designed to highlight both the codified, regulatory tools available to the community to assist with natural hazard mitigation as well as other community assets that may help facilitate the planning and implementation of natural hazard mitigation over time. The following Capability Assessment Matrix has been used as a basis for James City County's mitigation plan.

Table 5.4.6 - Capability Matrix – James City County

	James City County
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	Yes
-Effective Flood Insurance Rate Map Date	2-6-91
-Substantial Damage Language	Yes, but not called "substantial damage"
-Certified Floodplain Manager	No

	James City County
-Number of Floodprone Buildings	200
-Number of NFIP policies	476, as of 12/03
-Maintain Elevation Certificates	Yes
-Number of Repetitive Losses	7
CRS Rating	Class 9
Stormwater Program	Yes
Building Code Version Full-time Building Official	VUSBC (IBC 2003) Yes
- Conduct “As-built” Inspections	Yes
- BCEGS Rating	3
Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes
-Storm Ready Certified	No
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	Yes, just for Surry
-Emergency Notification (R-911)	Yes
-other (e.g., cable override)	CERT, cable over-ride
GIS system	Yes
-Hazard Data	Yes
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	Yes
Property Owner Protection Projects	Yes
Critical Facilities Protected	Not fully
Natural Resources Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

Form of Governance

James City County is divided into five election districts, each of which is represented by an individual who serves on the Board of Supervisors for four years. Current terms are staggered, with representatives from three of the districts elected in one year and representatives from the other two districts elected two years later. The Board of Supervisors passes all laws and determines all policies that govern the County. The Board appoints a County Administrator, most boards and commissions, appropriates funds for County operations, and generally oversees all County functions. The County Administrator is the chief administrative officer of the County and is responsible for executing Board policies. The Administrator acts as Clerk to the Board and handles the daily administrative operations of the County, as well as its long-range and strategic planning.

Guiding Community Documents
James City County has a range of guidance documents and plans for each of their departments. These include a comprehensive plan, strategic plans, streetscape policy guide, community appearance guide, and emergency management plans. The County uses building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the County guides its' future is through policies laid out in the Comprehensive Plan.

2003 Comprehensive Plan

James City County's *2003 Comprehensive Plan* features the following:

- A long-range plan for the physical development of the County by focusing on controlling residential growth while preserving the County's natural beauty, improving education and maintaining public services and a healthy economy.
- Land Use designations describing Conservation Areas as "critical environmental areas where ordinary development practices would likely cause significant environmental damage." These lands include wetlands, marshes, flood hazard areas, steep slopes, critical plant and wildlife habitats, and streambanks. Conservation areas should remain in their natural state. Development, if it occurs, should consider negative impacts and methods to mitigate or eliminate these impacts.
- Environmental concerns including: decreasing water supply and quality; increased soil erosion and stormwater runoff, loss of scenic vistas, destruction of wildlife habitats, deforestation, air pollution and loss of agricultural lands.
- Environmental goals focused on air, land, noise, solid waste, and water elements, including water quality, protecting wetlands, marshes and rivers from degradation, protecting shoreline property from erosion and minimizing the need for streambank and shoreline erosion controls. The floodplain management regulations are cited as contributing toward both water quality and shoreline erosion control.
- Maps and detailed sections regarding aquatic resources, shoreline and streambank erosion problems and public/private waterfront access areas.

James City County prepared a *Development Potential Analysis Report* in 2002 to identify and quantify the residential development potential of properties located within the County's Primary Service Area (PSA). The Real Estate Assessment Subdivision Data Zone Database was the primary source of reference for identifying parcels and their associated improvement value. A total of 3,850 platted/vacant lots were identified in residential zoning with development potential.

Current development pressure and projects under construction or site plan review are located west of Interstate 64, and primarily in the Berkeley Powhatan and Stonehouse Districts of the County, especially along Richmond Road in the southern part of Stonehouse. A special *Five Forks Study Area Traffic Impact Alternatives Analysis* was conducted in 2004 to identify and analyze the development and redevelopment potential within the Five Forks Area. Five Forks is a developed area in the immediate vicinity of the intersection of John Tyler highway (State Route 5) and Ironbound Road (State Route 615). The study focused on existing traffic conditions and expected traffic impacts associated with four future land use scenarios. Emergency evacuation does not appear to be a factor considered in the study.

Zoning & Development Standards

- Identifies existing Federal and state regulations for wetland, floodplain, and RPA/RMA protection.
- The document outlines required standards for new development and redevelopment based on use and zoning designation.

James City County has adopted a floodplain management ordinance that exceeds the minimum requirements of the NFIP. The Flood Zone District is designated as an Overlay District in County Code, Chapter 24, Division 3. The community has seven repetitive losses through the NFIP. Manufactured homes are not a permitted use in the floodplain, although there are some existing units in the floodplain and replacements are allowed with freeboard and proper anchoring. The ordinance outlines very specific hazardous materials/uses that are not permitted in the overlay district, including oil and oil products, radioactive materials, and specific poisons.

One foot of freeboard above the BFE is required for structures in the floodplain. Substantially damaged structures are addressed in §24-602 of the ordinance, entitled "Existing Structures in Floodplain Districts." Although the NFIP term "substantial damage" is not used, the resultant requirements are comparable. Flood hazard information is not currently noted on site plan applications or checklists, or the building permit application.

James City County participates in the NFIP's Community Rating System, and has maintained a Class 9 rating since 1992, rewarding property owners, countywide, with a five percent reduction in flood insurance premiums.

The County's Development Review Committee (DRC), a subset of the Planning Commission reviews large or complicated development plans proposed in the County. Emergency Preparedness, Police and Fire do not participate in DRC reviews; however, the DRC does hear presentations from County staff if there are specific issues requiring attention.

Stormwater Program

The County Environmental Division's role is to protect the natural resources through effective management of public and private land development and enforcement of environmental activities. Through Land Disturbance permits, the division enforces ordinances related to stormwater management, erosion and sediment control and the Chesapeake Bay Preservation Act. The division also promotes watershed management through development of watershed plans, specifically for Powhatan Creek and Yarmouth Creek.

To meet the requirements of the Chesapeake Bay Preservation and Sediment Control Ordinances, virtually all new commercial and residential developments in James City County require the construction of one or more Best Management Practice (BMP) facilities. The majority of BMP facilities are wet or dry ponds but a few are infiltration-type facilities. These facilities store stormwater runoff and treat the water by either slowly releasing the water over a 24-hour period or infiltrating it into the ground.

All BMP facilities require periodic maintenance to ensure that they function as designed and to prolong their useful life. Responsibility for this maintenance is assigned to the BMP owner(s) through a Declaration of Covenants for Inspection/Maintenance. In order to assist BMP owner(s) with the maintenance needs of their BMP, the Environmental Division inspects the BMPs on an annual basis and provides the results of the inspection to the owner(s). The staff also has information available that describes how to maintain the facilities and is available to make presentations to Homeowner Associations.

Public Education

Among the readily available public outreach mechanisms for James City County, the website (http://www.jccegov.com/index.html) provides residents with pertinent information, a property information tool and answers to numerous Frequently Asked Questions (FAQs). The County also posts most of its guiding documents, including the Comprehensive Plan.

The County has many different types of materials available for residents, businesses, teachers, youth, and adult groups. Emergency Preparedness offers refrigerator magnets, a Surry Nuclear Power Station calendar that includes siren testing dates, numerous materials on family disaster planning, and an emergency information flyer. The Surry calendar is distributed to all households within a 10-mile radius of the facility. Fire safety programs and presentations at fairs, shopping centers and community groups are regularly used to share information with the public. Regular programming on County television stations and the County emergency management hotline are additional resources that James City County residents can use to answer questions or learn more about hazards in the area.

County Development Management distributes a *Notice of Flood Hazard* flyer to owners of buildings located in or near floodplains in the County as part of the annual County Flood Hazard Awareness Program. The public library maintains extensive literature on flood hazards and floodplain development.

Emergency Preparedness

Emergency Alert System (EAS) is a national civil emergency alert system that uses message relays between member radio and television stations to inform the public about immediate threats to national security, life, and property. EAS is now routinely used for severe weather warnings and can also be employed to disseminate Amber Alerts for missing children. The enhancement is an initiative of Governor Warner's Secure Virginia Panel designed to improve statewide preparedness, response, and recovery capabilities for emergencies and disasters. Governor Mark R. Warner announced June 5, 2004, that Virginia will enhance its public warning capabilities with a new satellite-based system that can rapidly transmit EAS messages throughout the Commonwealth. In James City County, warnings are disseminated by radio, TV, weather radio and by police and fire vehicles equipped with public address systems.

The County has contracted with a private radio station for future public disaster-related information specific to James City County. In cooperation with Williamsburg, James City County is installing digital text alert systems for severe weather in public buildings, including schools and libraries. The system incorporates Thunder Eagle Alert System technology which relays weather, Amber and emergency alerts to email, text messaging cell phones and pagers for a large group of people, possibly including government officials, broadcast engineers and emergency management staff. Emergency management officials work closely with the School Board's emergency planner before, during and after disasters. James City County also has a Reverse 9-1-1 system to facilitate telephone contact with select groups of residents based on the nature and location of an impending event. The County maintains an ongoing database of County emergency response incidents and each incident is geographically referenced.

James City County's evacuation planning is prepared by the Virginia Department of Transportation. Phase 1 and Phase 2 evacuation routes are shown and discussed online at http://www.virginiadot.org/comtravel/hurricane-evac-hro.asp. Special needs residents can sign up with Heads Up, James City County's assistance program for residents with special needs such as hearing impaired or wheelchair bound. The confidential database system is activated should emergency personnel need to respond to a medical emergency at an address or during a countywide disaster. Retirement and nursing homes in the area have been extremely pro-active in preparing their facilities to shelter residents in-place during disasters.

James City County's Community Emergency Response Team (CERT) program helps the community respond to disasters during the first 72 hours following a disaster when flooded roads, disrupted communications, and emergency demand outweigh local emergency services. The purpose of CERT training is to provide private citizens with basic skills to handle virtually all of their own needs and then to respond to their community's needs in the aftermath of a disaster.

The Citizen Fire Academy is designed to introduce citizens to the Fire Department, its mission and role in public safety, and to train citizens on their role and responsibilities in fire and life safety. Participants receive information on disaster programs and response, fire extinguisher training, CPR, and how to access the Enhanced 911 system in the most efficient manner.

The Neighborhood Connections program provides a mechanism for relaying pertinent information to homeowners' association leaders in remote areas, with the expectation that these persons could further distribute the information to all residents.

Other Mitigation Activities
Following Hurricane Isabel, the County requested and received FEMA HMGP funds to elevate three homes in Chickahominy Haven. The neighborhood contains many of the County's repetitive losses.

The County has installed diesel generator backup power at the EOC and tied communications to the County intra-net. Satellite service and a standard outside antenna provide additional backup during emergencies. Ham radio operators in the EOC assist with communications during events.

Every one of the 10 schools in the County is approved by the American Red Cross to operate as an emergency shelter. The primary shelter at the James City County/Williamsburg Community Center is configured to receive an emergency generator in case of power outages. Jamestown Elementary School and Stonehouse Elementary School are also prepared for an emergency generator.

The James City County Environmental Division has recently initiated a drainage improvement program, previously authorized by the Board of Supervisors. The purpose of this program is to correct existing drainage and erosion problems that are adversely impacting landowners and the environment. The Environmental Division works with landowners and homeowner associations in the design, contracting and supervision of the restoration work. More than a dozen sites included as projects within James City County have already been identified and prioritized for 2005.

5.5 York County Profile

The following sections present a detailed assessment of critical hazards that affect York County. Understanding these hazards will assist the Peninsula region in its process of identifying specific risks and developing a mitigation strategy to address those risks.

5.5.1 Flooding – York County

The geographic location of York County makes it extremely susceptible to coastal flooding. Storms associated with coastal flooding include tropical cyclones and nor'easters. These types of events typically drop large amounts of rain and generate high winds that result in storm surge. Storm surge is essentially the water that is pushed toward the shore by the persistent force of the winds of an approaching storm. It should be noted that astronomical tides occur independent of climatic conditions. Depending on the tide level at the time of land-falling storms, surge may be elevated. Flash flooding and urban flooding are also a concern within the County limits.

As part of the NFIP, FEMA created a Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for York County. In addition, the NCDC tracks the occurrence of flooding events for communities across the nation. York County has developed surge elevations for its parcel data set. All of these data sources were utilized in developing the hazard identification and vulnerability assessment.

FEMA published a FIS for York County, dated December 16, 1988. The FIRMs, which accompany this FIS delineate the 100- and 500-year flood hazard boundaries for flooding sources identified in areas of growing development or areas predicted to have future development, at the time of the report. A detailed wave height analysis was developed in order to delineate the 100- and 500-year flood hazard boundaries for the County. This analysis resulted in a 100-year stillwater elevation of 8.5 feet for the County and a maximum 100-year wave crest of 11 to 13 feet. The significant flood events outlined in the FIS are given below in Table 5.5.1a.

Table 5.5.1a- Significant Flood Events – York County

Date	Storm	Tide Elevations
August 1933	Hurricane	Max tide heights averaged 8 feet
April 1956	Nor'easter	Not given
October 1957	Hurricane – Not Named	Not given
September 1960	Hurricane Donna	Not given
March 1962	Nor'easter	Max tide heights averaged 6.8 feet

Source: FEMA 1988

The NCDC operated by NOAA keeps a record of significant weather related events and damage estimates for the entire country. Listed below (Table 5.5.1b) are the significant events that have affected York County, according to that database.

Table 5.5.1b- NCDC Listed Significant Flood Events –York County

Date	Event	Precipitation	Comments
1989 (not in NCDC database)	Thunderstorm with urban flooding	Not given	▪ Urban flooding costs estimated at $500,000 in York County.
September 22, 1994	Coastal Flooding	Not given	▪ Caused minor local flooding along Water Street in Yorktown
April 23, 1997	Coastal Flooding	Not given	▪ Minor coastal flooding was reported in portions of Newport News and York County
January 27, 1998	Coastal Flooding	Not given	▪ Residential homes sustained severe damages ▪ Gale force winds caused damage to power lines which caused power outages locally
February 4, 1998	Coastal Flooding Nor'easter	Not given	▪ Caused severe flooding ▪ Buildings were evacuated ▪ Widely spread power outage ▪ $314,000 in costs incurred by York County government
September 15 to 17, 1999	Hurricane Floyd	12 to 18 inches	▪ Numerous roads washed out due to flooding ▪ Flooding considered 500-year flood ▪ Enormous crop damage

As with the entire Peninsula planning area, there are obvious data gaps when combining the FIS and NCDC databases. Recent, noteworthy urban-type flood events in the County have included:

- Hurricane Floyd (1999) affected the neighborhoods of Tabb Lakes, Coventry, Running Man and Foxwood. Insufficiently sized culverts, culvert blockages, and intense rainfall contributed to the drainage problems.
- July 24, 2000, intense rainfall affected the Tabb Lakes and Coventry subdivisions.
- Hurricane Isabel (2001) resulted in flooding of some streets and intersections in many of the same subdivisions listed above, but no significant flooding of structures was noted.

The County has been working with residents recently to identify and abate these drainage problems. As a result of Hurricane Floyd, Newport News Waterworks made changes to their reservoir management practices to be more proactive in adjusting reservoir elevations ahead of storm systems that are predicted to produce excessive rainfall amounts. Residents indicate that Little Brick Kiln Creek, which is on the Newport News/York County boundary, is a major outfall for several York County tributaries with very low slopes. Maintenance of the creek by all stakeholders (including the U.S. Army which also has land holdings in the area) is critical to maintaining sufficient drainage using existing infrastructure.

5.5.2 Hurricanes – York County

The FIS for York County identified four historic hurricanes that affected the County (see Table 5.5.1a above); however, specific damage estimates were not given. The NCDC dataset listed five hurricanes for York County for the period between 1950 to June 2004. These storms are listed in Table 5.4.2. County records and other National Weather Service data provide dates of earlier storms and identify a number of hurricanes to include the damaging event in August 1933. These storms are included in Table 5.5.2.

Typical York County damage from Isabel where trees fell into power lines

Hurricane Fran (1996) created power losses to 140,000 people across the Peninsula. Additionally, four people died within York County as a result of Fran.

Hurricane Floyd (1999) moved through the area dropping 18 inches of rain within 24 hours. Trees and power lines were knocked down and roads were flooded; over 5,500 homes were left without power.

Hurricane Isabel made landfall on September 18, 2003, as a Category 2 hurricane near Drum Inlet, North Carolina. Hurricane Isabel is considered to be one of the most significant tropical cyclones to hit this area since hurricane Hazel (1954) and the Chesapeake-Potomac Hurricane of 1933. Isabel produced storm surges six to eight feet above normal high tide levels and is directly responsible for 10 deaths in Virginia and indirectly responsible for 22 deaths. Isabel caused widespread wind and storm surge damage in eastern North Carolina and southeastern Virginia, currently estimated at $925 million in Virginia. All of the above data was taken from the NOAA Tropical Cyclone Report for Hurricane Isabel (Beven and Cobb, 2004).

In York County, Hurricane Isabel reportedly destroyed 55 homes. Debris removal alone cost the county over $10.6 million. There were 900 flood insurance claims through the NFIP, which represent only a small portion of the total number of homes that were damaged by floodwaters. The Small Business Administration provided loans for home repair totaling $9 million, and loans for businesses totaling $909,000. FEMA housing assistance other needs assistance in the County totaled $2.6 million

Table 5.5.2- Historic Hurricanes – York County

Date	Storm Name	Category	Descriptions
August 23,1933	Chesapeake-Potomac Hurricane	Category 1/Tropical Storm	▪ Extensive damage to areas along the York River and Chesapeake Bay. Tide levels of 6-9 feet above MLLW over a large portion of the Bay. Peak wind gusts at Cape Henry were 88 mph.
August 19, 1985	Danny	Extratropical System	▪ Tracked over York County
September 6, 1996	Fran	Tropical Storm	▪ 4 deaths in York County associated with the storm ▪ Water Street and other areas flooded ▪ High winds, and 140,000 on the Peninsula without power.
July 12, 1996	Bertha	Tropical Storm	▪ 170,000 people on the Peninsula without power. Tracked over York County.
August 29, 1998	Bonnie	Tropical Storm	▪ 51,000 people on Peninsula without power.
September 1, 1999	Dennis	Hurricane/Tropical Storm	▪ Prolonged period of tropical cyclone ▪ Highest sustained winds at Langley 52 mph ▪ Tide 3 feet above normal ▪ Coastal flooding ▪ 2 to 5 inches of rain ▪ $27,000 damage
September 15, 1999	Floyd	Category 1/Tropical Storm	▪ Spawned 2 tornados ▪ Hundreds of downed tress ▪ Tide 3.9 feet above normal ▪ Numerous roads washed out ▪ $99.4 million in property damage over the entire affected area ▪ 18" of rainfall in York County
September 18, 2003	Isabel	Category 1/Tropical Storm	▪ Hundreds of downed tress ▪ Loss of power ▪ Damaged residents and businesses ▪ Greatest storm surge since Hazel
August 18, 2004	Charley	Hurricane	▪ Uprooted of trees and downed numerous power lines ▪ Over 2 million Virginians without power ▪ Heavy rain and wind gusts
August 30, 2004	Gaston	Tropical Depression	▪ Hard rains that produced flooding ▪ Roads under water ▪ Power outage (99,600 statewide) ▪ 2 F0 Tornados confirmed in York County.
September 8, 2004	Frances	Hurricane	▪ Generated 9 tornados in Central Virginia ▪ High winds ▪ Large amounts of rainfall/flooding
September 17, 2004	Ivan	Hurricane	▪ Spawned unconfirmed tornados ▪ Power outage (66,000) ▪ Heavy rain/flooding
September 28, 2004	Jeanne	Hurricane	▪ Flash flooding/heavy rainfall ▪ Power outage

5.5.3 Tornados – York County

York County has experienced five tornados over the period of 1896 to 2003 (Table 5.5.3), which have caused a variety of damage. The most significant tornado occurred on October 14, 1986, which generated wind of 110 mph and cause $1.8 million in damages over the entire affected area.

Table 5.5.3- Historic Tornados – York County

Date	Magnitude	Deaths	Injuries	Descriptions
July 8, 1896	Not Given	Not Given	2-5	▪ Spawned by a hurricane ▪ Barns and small houses destroyed
May 8, 1984	Not Given	Not Given	Not Given	▪ Spawned by severe thunderstorms ▪ Destroyed three mobile homes
October 14, 1986	F2	Not Given	Not Given	▪ Down burst of 110mph ▪ Damages of $1.8 million over entire affected area
August 7, 1993	F0	0	0	▪ Damage to several structures in the Lackey area.
August 2003	F0	0	0	▪ Damage to structures in Running Man subdivision in the Tabb area, winds in the 80 MPH range.
August 30, 2004	F0 (2)	Not Given	Not Given	▪ Associated with Gaston

5.5.4 Erosion – York County

York County is unique among Peninsula communities because the shoreline erosion hazard has historically caused more damage, and has the potential for additional damage in the future. The hazard, however, is pertinent from a land use perspective only and poses little threat to human life, health or safety. Furthermore, the erosion hazard is a secondary hazard caused by storms and sea level rise. The uniqueness of York County's erosion hazard merits additional consideration in this section, and is also discussed and mapped in detail in the County's 2025 Comprehensive Plan which should be referenced for additional information and graphics. The information below is taken primarily from the Comprehensive Plan.

York County's shoreline consists of sheltered fine sand beaches, coarse sand beaches, exposed tidal flats, sheltered tidal flats, fringing intertidal marshes, supratidal marshes partially protected by elevation, and freshwater marshes and swamps. There are approximately 2,308 acres of marshes in the County.

York County encompasses approximately 207 miles of shoreline. The upper County drains via a system of streams and rivers, to the southern reach of the York River. This area is characterized by rolling terrain with well-drained soils and elevations up to 100 feet above mean sea level. In isolated areas, moderate to severe erosion has been noted. The lower County drains via a system of creeks and rivers to the Chesapeake Bay. The lower County section of shoreline includes

Wormley Creek, Back Creek, Chisman Creek, a portion of the Poquoson River, and the western shore of the Chesapeake Bay. Low flat lands with a relatively high water table characterize the topography of the lower County.

The impacts of natural and human activities on the shoreline can be measured by erosion rates, which are used to determine the most appropriate method to address erosion. The Chesapeake Bay Local Assistance Department suggests classifying eroding shorelines as slight (less than 1 foot per year), moderate (1 to 3 feet per year), or severe (more than 3 feet per year.)

In York County, the western shore of the Chesapeake Bay presents a unique challenge. The two areas with severe erosion are Reach 109 (the Bay Tree Beach/York Point area) and Reach 30 (the Waterview Road area west of the entrance to the Thorofare), both of which historically experience moderate to severe erosion rates of up to 3.5 feet per year. Although there is residential and industrial development along both of these shorelines, the erosion does not appear to be associated with the development. Most of the homes were built more than 10 years ago and are set back from the shoreline, although some homes along Dandy View Lane and Waterview Road are endangered. The erosion is due in large part to wave action associated with the physical alignment of the shore and prevailing storms. The York County Wetlands Board has approved several permits along Reach 30 for riprap, breakwaters, and marsh toe stabilization structures. The Bay Tree Beach area is much less developed than the Sandbox area. Most of these properties are not developed because the soils and high water table preclude on-site sewage disposal systems.

The rate of erosion in the remainder of the County along the York River is slight to moderate. The shoreline at the mouth of the river is vulnerable to the high-energy waves generated by the dominant northeast storms. The Yorktown historical area and recreational beach are along this shoreline. There is an ongoing project to stabilize the beach with a combination of methods, including riprap, breakwaters, beach nourishment, and vegetation. In addition, just south of Yorktown, the National Park Service is pursuing a project to stabilize the shoreline at the base of the significant bluff in the Moore House Road area.

5.5.5 Wildfire - York County

Many wildfires are caused by human acts like arson or careless accidents, or through natural occurrences, such as lightning strikes. Wildfire danger can vary greatly season to season and is often exacerbated by dry weather conditions. The high productivity and the tendency for the previous year's growth to remain interspersed among the current year's growth create a wildfire danger. VDOF has created Fire Risk Assessment Maps designed to help communities determine areas with the greatest vulnerability to wildfire.

The Wildfire Risk Assessment Map (Appendix B) delineates the aerial extent of wildfire vulnerability within York County. Approximately 34,322 acres (50 percent) of the County falls in a high wildfire risk area. York County determined that 5,906.5 acres (17 percent) of that total are federally-controlled land. Parameters used to establish these risk boundaries are based on land use, population density, slope, land cover and proximity to roads. The proximity of the tree lines or brush to the highway or roadway is also included in the wildfire risk analysis to capture the human/wildfire causal relationship. Travel corridors increase the probability of human presence across a landscape, thereby increasing the probability of wildfire ignition. As such, areas closer to roads are much more likely to attain a higher ignition probability.

York County is currently experiencing an accelerated development rate. Land that once was rural and relatively inaccessible is now either under development or planned for development. Although the clearing of land for development removes potential fuel sources for wildfire, the wildfire hazard is not necessarily diminished because human access to the area is significantly increased. This development trend expands the wildland/urban interface, which places structures in close proximity to large amounts of vegetation, which increases the risk of wildfire (NWUIFPP undated).

5.5.6 Vulnerability Assessment – York County

The PHMPC conducted a vulnerability analysis for each critical hazard threatening York County. As several of these hazards are prone to occur in any part of the County, the exposure associated with tornados and winter storms is assumed to include the entire County. This section describes the method used to perform the vulnerability analysis for each hazard and then lists the results.

Flooding – York County

The York County Computer Support Services Division provided the tax parcel layer and tax assessor database for the entire County. They also provided a digital copy of the FEMA delineated floodplain information for the County. The detailed and approximate 100-year flood hazard layers were merged into one layer and intersected with the parcel layer. Any tax parcel that intersected the delineated floodplain was considered to be inside the floodplain and its building improvement value was added to the total property value in the 100-year floodplain.

Based on data from Spring 2005, the county parcel layer contains a total of 24,890 parcels. Approximately 4,265 of these parcels intersect the 100-year flood hazard boundary, which results in an at risk value of $1,393,066,000. Furthermore, York County provided an analysis of the hurricane storm surge zones based on digitized data provided by the Army Corps of Engineers. That study estimates that 8,929 parcels are located in a hurricane Category 4 storm surge zone, with an at-risk value of $2,225,806,700.

FEMA has developed a concept to highlight the impact that repetitively flooded structures have had on the NFIP. The term “repetitive loss,” as applied to the NFIP, refers to any property for which two or more flood insurance claims in excess of $1,000 each in a 10-year period of time have been paid. In 1998, FEMA reported that the NFIP's 75,000 repetitive loss properties had already cost $2.8 billion in flood insurance payments and numerous other flood prone properties continue to remain at high risk in the nation's floodplains. While these properties make up only one to two percent of the flood insurance policies currently in force, they account for 40 percent of the country's flood insurance claim payments. A report on repetitive loss structures completed by the National Flood Insurance Program found that 20 percent of these structures are listed as being outside of the 100-year floodplain (Conrad et al. 1998).

Including flood insurance claims paid as a result of flood damage caused by Hurricane Isabel in 2003, FEMA has identified 30 structures as repetitive loss structures in York County.

Hurricane – York County

Hazards U.S. – Multi Hazard (HAZUS®*MH*) was utilized to perform a wind hazard analysis for the entire Peninsula region. HAZUS®*MH* software is a multi-hazard loss estimation program that was developed under a cooperative agreement between the National Institute of Building Sciences and FEMA. The current version of HAZUS®*MH* has the ability to calculate earthquake, wind, and flood hazards as well as potential economic losses associated with these hazards. The software is designed with the flexibility to perform loss estimations at three different levels. Level 1 utilizes all default parameters built into the software. Levels 2 and 3 require user defined scenarios and building inventory data. For the purpose of this Plan, a Level 1 wind analysis was performed to calculate the wind hazard for each Peninsula community. The probabilistic scenario activates a database of many thousands of storm tracks and intensities. This scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year.

Table 5.5.5a lists the total dollar value of exposed structures for York County based on the 2002 Census data. Although current development trends in York County may render the 2002 Census data somewhat obsolete, this analysis depicts the probability of occurrence and can generally be used to estimate potential damages due to high winds.

Table 5.5.6a- Value of Exposed Structures from HAZUS®*MH* – York County

Occupancy Type	Value Exposed Structures ($1,000)
Residential	$3,238,262
Non-Residential	$348,300
Total	**$3,586,562**

The probabilistic analysis generated with the HAZUS®*MH* software utilized the same building stock information listed above. The probabilistic scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year. The probabilistic method was used to generate loss estimations of storms with specific recurrence intervals; 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year. Since residential structures comprised a significantly large percentage of the occupancy classification these data are presented in Table 5.5.5b below.

Table 5.5.6b-Summary of Probabilistic Analysis – Residential Structures – York County

Return Period	Residential Building Damage – Number of Buildings			
	Minor	Moderate	Severe	Destruction
10-year	7	1	0	0
20-year	118	7	1	0
50-year	1,257	111	13	1
100-year	1,754	214	23	5
200-year	6,121	1,732	262	159
500-year	7,679	3,595	960	695
1000-year	6,806	5,229	2,552	2,327

Hurricane Isabel- Structural Damage in York County

Winter/Ice Storm Vulnerability

Snow and ice storms usually associated with coastal storms do occur on the Peninsula (Table 5.5.5c). The weight of snow and ice on utility lines (power, cable, telephone) and trees causes lines to break and tree limbs to fall and break utility lines, block roads, and damage structures. During the Christmas ice storm of 1998, some York County residents were without power through the entire holiday week and into the first week of January. Tree damage that resulted from this storm was significant and the County spent several months in debris cleanup. VDOT, which maintains the Interstate system, also maintains the primary and secondary roads in York County. VDOT is responsible for snow plowing and sanding these roadways. The National Park Service (NPS) manages and maintains the Colonial Parkway, which provides another route to the northern end of York County. NPS can close the parkway when there is a threat of falling trees or when the tree damage is extensive and road conditions are unsafe.

Table 5.5.6c- Recent Winter Storms – York County

Date	Magnitude	Descriptions
March 1993		
January 6, 1996		Property Damage, $50 thousand damage
January 27, 1998		Property Damage, $20 million damage
February 5, 1998		
December 23, 1998	½-inch of ice coated trees, roads, and utility lines.	Power outages, structural damage, and debris removal

Tornado Vulnerability – York County

The facilities and building stock that were identified as exposed under hurricane hazards are also exposed to tornado hazards. Tornados are random natural events that strike with little warning but are associated with thunderstorms and hurricanes.

Wildfire – York County

VDOF was utilized to estimate the wildfire risk for York County. This data layer was intersected with the County's tax parcel mapping in order to estimate the value of at risk structures. Approximately 50 percent of the County is located within the high wildfire risk zone. This area includes 14,584 parcels with an at risk improvement value of $4,711,794,700.

Critical Facilities

In order to assess the vulnerability of a community to natural hazards, the PHMPC conducted an inventory of York County structures and critical facilities (Appendix E). Critical facilities are those facilities that warrant special attention in preparing for a disaster and/or facilities that are of vital importance to maintaining citizen life, health, and safety during and/or directly after a disaster event.

The inventory of critical facilities for York County includes emergency response facilities such as police stations, fire departments, emergency medical service stations (EMS), public facilities including schools and local government buildings. Those facilities that are geographically located within a hazard zone are listed below (Tables 5.5.5d, 5.5.5e, and 5.5.5f).

Table 5.5.6d- Critical Facilities at Risk – 100-Year Floodplain

Name	Code	Number
**Overlook Point	PS	208
Barcroft	PS	169
Brandywine	PS	174
Carys Chapel Rd.	PS	194
Crestwoods	PS	196
Dandy Vac Sta.	PS	199
Hollywood	PS	166
Jonadab Rd.	PS	206
Marlbank Cove	PS	185
Mill Cove	PS	175
Olde Port Cove	PS	182
Seaford Vac. Sta	PS	198
Yorkshire Downs	PS	187

Source: AMEC
Critical Facility Key Code, see Appendix E

Table 5.5.6e- Critical Facilities at Risk – Surge Zone Hurricane Category 4

Name	Code	Number
**Overlook Point	PS	208
Barcroft	PS	169
Belmount Apts	PS	202
Brandywine	PS	174
Calthop Neck Vac	PS	201
Cary's Chapel 2	PS	200
Carys Chapel Rd.	PS	194
Crestwoods	PS	196
Dandy Vac Sta.	PS	199
Dare Heights	PS	215
Dare Vacuum Sta.	PS	213
Hollywood	PS	166
Hornsbyville Rd.	PS	160
Jonadab Rd.	PS	206
Kings Villa	PS	162
Lakes Of Dare	PS	195
Lindsay Landing	PS	207
Marlbank Cove	PS	185
Mill Cove	PS	175
Moss Avenue	PS	167
Olde Port Cove	PS	182
Pinehurst Vac	PS	173
Read Street	PS	158
Running Man 1	PS	183
Running Man 2	PS	189
Scotch Toms	PS	176
Seaford Station Number 6	FR	62
Seaford Vac. Sta	PS	198
Sommerville	PS	163
Tidemill	PS	197
Whispering Winds	PS	184
Yorkshire Downs	PS	187
Yorktown Road	PS	214

Source: AMEC
Critical Facility Key Code, see Appendix E

Table 5.5.6f- Critical Facilities at Risk – High Wildfire Hazard Zone

Name	Code	Number
**Corvette	PS	205
*Colony Pines	PS	220
Banbury Water	PS	210
Baptist Rd.	PS	192
Barcroft	PS	169
Brandywine	PS	174
Calthop Neck Vac	PS	201
Cary's Chapel 2	PS	200
Carys Chapel Rd.	PS	194
Cockletown Road	PS	161
Crestwoods	PS	196
Dare Vacuum Sta.	PS	213
Environmental Services Building	GO	225
Finance Building	GO	227
Ft. Eustis Blvd.	PS	168
General Services	GO	229
Goosley Road	PS	177
Grafton High/Middle School	SC	58
Grafton Woods	PS	172
Griffin-Yeates Center	GO	228
Hollywood	PS	166
Hornsbyville Rd.	PS	160
Kiln Creek 2	PS	181
Lackey	PS	186
Landfill	PS	165
Lightfoot Sta.	PS	212
Lindsay Landing	PS	207
Lodge Road	PS	178
Marlbank Cove	PS	185
Mill Cove	PS	175
Moss Avenue	PS	167
Mount Vernon Elementary School	SC	56
Olde Port Cove	PS	182
Oriana Road	PS	164
Penniman East	PS	155
Pierpoint Place	PS	156
Pinetree Road	PS	151
Public Safety Building	GO	223
Queens Lake Middle School	SC	137
Queenslake	PS	217
Read Street	PS	158
Road Water Sta.	PS	209
Route 17	PS	170

Name	Code	Number
Royal Grant	PS	152
Running Man 1	PS	183
Schooner Blvd	PS	204
Scotch Toms	PS	176
Seaford Station Number 6	FR	62
Solid Waste Management Center	GO	224
Tabb High School	SC	80
Tabb Library	LB	222
Tabb Middle School	SC	55
Tabb Station Number 2	FR	134
Tidemill	PS	197
Williamsburg Hosp.	PS	203
York High	PS	179
York/Poquoson Courthouse	GO	226
Yorktown Elementary School	SC	61
Yorktown Library	LB	221
Yorktown Middle School	SC	63
Yorktown Road	PS	214
Yorktown Station Number 4	FR	122

Source: AMEC
Critical Facility Key Code, see Appendix E

This inventory highlights that some critical facilities, such as the Barcroft Pump Station, are in areas subject to multiple hazards. This should be taken into consideration when action is taken to protect York County's critical facilities.

5.5.7 Capability Assessment – York County

As an additional tool to assist with the examination of the hazards identified and to evaluate the community's ability to plan, develop, and implement hazard mitigation activities, the planning team developed a local capability assessment for York County. This assessment is designed to highlight both the codified, regulatory tools available to the community to assist with natural hazard mitigation as well as other community assets that may help facilitate the planning and implementation of natural hazard mitigation over time. The following Capability Assessment Matrix has been used as a basis for York County's mitigation plan.

Table 5.5.7 - Capability Matrix – York County

	York County
Comprehensive Plan	Yes
Land Use Plan	Yes, part of the Comprehensive Plan
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	Yes
-Effective Flood Insurance Rate Map Date	12-16-88

	York County
-Substantial Damage Language	Yes
-Certified Floodplain Manager	No
-Number of Floodprone Buildings	4,265 parcels
-Number of NFIP policies	2,079
-Maintain Elevation Certificates	Yes
-Number of Repetitive Losses	30
CRS Rating	Class 9
Stormwater Program	Yes
Building Code Version Full-time Building Official	VUSBC (IBC 2003) Yes
- Conduct "As-built" Inspections	Yes
- BCEGS Rating	3
Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes
-Storm Ready Certified	No
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	Yes, just for Surry
-Emergency Notification (R-911)	Route alerting plans and an automated system in the planning phase.
-other (e.g., cable override)	Cable override & agreement with radio station.
GIS system	Yes
-Hazard Data	Yes
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	Yes
Property Owner Protection Projects	Yes
Critical Facilities Protected	Partially
Natural Resources Inventory	Yes – limited
Cultural Resources Inventory	Yes – limited
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Web site & online Customer Service Utility
Environmental Education Program	Yes

Form of Governance

The York County Board of Supervisors is comprised of five elected citizens, one from each of the five election districts. Supervisors serve four-year terms with the Chairman and Vice

Chairman elected annually by the five-member board. The Board of Supervisors serves, by law, as the governing body of the County, charged with administering County functions which include: preparation of the budget and appropriation of funds; appointing members of various boards and committees; levying taxes; constructing and maintaining County buildings; adopting the comprehensive land use plan and approving and enforcing related ordinances; and adopting and enforcing ordinances for police, sanitation, health, and other regulations permitted by state laws.

Guiding Community Documents

York County has a range of guidance documents and plans for its departments. These include a comprehensive plan, a build-out study, a citizen's guide on land development, transportation studies, Yorktown Historic District and Design Guidelines, and emergency management plans. The County uses building codes, zoning and, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the County guides its future is through policies laid out in the Comprehensive Plan.

Charting the Course to 2025: The County of York Comprehensive Plan

The Code of Virginia requires all cities and counties in the state to have a comprehensive plan and to review it every five years to determine if it needs to be revised. York County's *Comprehensive Plan, first adopted in 1991, and updated in 1999 and 2005,* features the following:

- The long-range plan for the physical development of the County, including what kind of development – single-family residential, commercial, multi-family residential, industrial, etc. – is considered desirable and appropriate for each area of the County.
- Data that guides development to appropriate areas of the County based on the carrying capacity of the land, the existing development character, the presence of infrastructure and public facilities, and natural resources.
- Extensive public participation efforts. The Comprehensive Plan Review Citizen Input Process used for the 1999 plan update received an Achievement Award from the National Association of Counties in 1997.
- Environmental goals focused on air, land, noise, solid waste, and water elements, including water quality, protecting wetlands, marshes and rivers from degradation, protecting shoreline property from erosion and minimizing the need for streambank and shoreline erosion controls.
- Maps of wetlands, flood hazard areas, Chesapeake Bay Preservation Areas, watershed protection areas, areas of high soil erodibility, areas with high water tables, areas with shrink/swell soils and areas with steep slopes.
- An estimate of maximum build-out population, the total number of people who would be living in York County if all the residential land were developed at its highest allowable density. The plan established 80,000 as the desirable maximum build-out population, and residential land use densities were established and applied to areas of the County with the intent of achieving this goal. The County appears to be on track toward meeting this goal,

with an estimated maximum build-out figure of approximately 81,000 under almost any realistic development scenario.

- Plans for continued growth and development in designated areas, including but not limited to:
    - South County; south of Ft. Eustis Blvd., and east of Rte. 17
    - North County; Lightfoot exit off of Interstate 64
    - Potential Mixed Use areas identified along Route 17 on Denbigh Boulevard, and in the Lightfoot and Skimino areas of upper County.
- Citizen comments through surveys, neighborhood meetings and committees (currently being gathered for input to the comprehensive plan updated for 2025).

Zoning & Development Standards

- Identifies existing federal and state regulations for wetland, floodplain, and Resource Protection Area and Resource Management Area (RPA/RMA) for Chesapeake Bay protection.
- Outlines required standards for new development and redevelopment based on use and zoning designation.

York County has adopted an ordinance that exceeds the minimum requirements of the NFIP. The ordinance designates the Flood Zone District as an Overlay District in County Code, §24.1. The community has 30 repetitive losses through the NFIP. Manufactured homes are not permitted in the floodplain, although there are some existing units in the floodplain. The ordinance outlines very specific hazardous materials/uses that are not permitted in the overlay district, including oil and oil products, radioactive materials, and specific poisons. The finished crown/centerline elevation of all new public or private streets must be at least 6½ feet above mean sea level (NGVD). The ordinance contains floodplain fill regulations that exceed minimum NFIP standards. Construction standards for structures in Zones A, AE and V reference the Virginia USBC and the requirements therein. The ordinance does not mandate additional freeboard for development; however, freeboard between one and a half feet and three feet above BFE is strongly recommended and the ordinance notes that a reduction of flood insurance premiums may result. Development in approximate A Zones requires that detailed hydrologic and hydraulic analyses be used to determine a BFE and 100-year floodplain boundary for the property. Flood hazard information is not currently noted on the Building Permit Application, but must be included on site plans submitted for review. Residential permit applicants must complete the *Preliminary Natural Resources Inventory* worksheet that includes indicators of the presence of regulatory wetlands.

The zoning and code enforcement staff within the Department of Environmental and Development Services regulate land use and development activities and elimination of property-related nuisances. The Zoning Section is responsible for zoning code enforcement and the elimination of property-related nuisances such as tall grass, weeds and junked cars. The Board of Zoning Appeals is responsible for reviewing and hearing appeals from decisions of County administrative officials concerning the zoning and subdivision ordinances; considering requests for variance relief from the requirements of these ordinances; and considering exceptions to the Chesapeake Bay Preservation Area Regulations. The department coordinates weekly staff-level reviews of site plans and proposed projects.

Stormwater Program

The York County Department of Environmental and Development Services review all new development in the County for compliance with state and county regulations. Offsite flow must be maintained at the same rate as before development if the downstream system is not adequate for increased flows. Installation of Best Management Practices (BMPs) such as wet ponds or lakes, and dry ponds, as well as other engineered systems are typically used.

In addition, when the County receives complaints/inquiries about drainage problems, the staff complete a study to determine if there are easements, and whether the County has responsibility to correct the problem. Staff makes recommendations for addressing the issue that may include developing a project plan and adding it to the Capital Improvement Plan list and ranking it with other projects in the schedule.

The County is working on drainage improvements for the Tabb Lakes outfall, Foxwood outfall, Moores Creek, which drains Woodlake, Running Man and properties in-between, Edgehill Drainage Study, and the Brandywine subdivision.

The County also has a Stormwater Advisory Committee (SAC) with the express goals of:

- Developing and implementing a public education and outreach program on stormwater issues,
- Increasing public involvement and participation in stormwater issues,
- Providing increased citizen access to County staff for stormwater and drainage issues, and
- Assisting County staff and the Board of Supervisors in identifying drainage problems and developing priorities for stormwater drainage projects.

The SAC has electronically posted and distributed copies of the committee's brochure, *A Homeowner's Guide to a Healthy Stormwater Drainage System*, and two important Fact Sheets entitled, *What You Can Do to Reduce Flooding in Your Area*, and *What You Can Do to Reduce Pollution In Your Area*. These documents are a means of educating the public about preventing flooding and maintaining drainage systems.

The Committee developed a presentation entitled *How to Reduce the Chance of Flooding* that is presented at HOA meetings and on the County's Community TV during hurricane season. The Committee also worked with the U.S. Army and U.S. Air Force, whose property borders York County, to ensure a coordinated approach to stormwater maintenance.

Public Education

Among the readily available public outreach mechanisms for York County, the website (http://www.yorkcounty.gov) provides residents with pertinent information, and answers numerous Frequently Asked Questions (FAQs). The County also posts most of its guiding documents, including the Comprehensive Plan on this site. The County publishes a quarterly newsletter (CITIZEN NEWS), which is mailed to every household. The County maintains a government access TV channel using Cox Cable.

York County's Department of Fire and Life Safety provides a number of fire and life safety programs and maintains a stock of different types of educational materials available for residents, businesses, teachers, youth and adult groups. A Fire Prevention Educator provides child fire safety programs in the schools. The Department of Fire and Life Safety works with other County agencies and departments to sponsor *Safety Town*, a program for pre-school children in the summer to teach programs, such as fire safety, bike safety, electrical safety and disaster preparedness. The Department partners with the Sheriff's Office, York County Chamber of Commerce, the York-Poquoson American Red Cross and other County organizations to promote life safety and preparedness. The Department's Office of Emergency Management promotes disaster preparedness year-round through public programs (some mentioned above) and in the County quarterly newsletter to residents. In 2005, the Office of Emergency Management partnered with a local home improvement store to promote preparedness during the Christmas season. The Department's web site promotes emergency preparedness and life safety.

The Department of Environmental and Development Services Online Customer Service System provides a service for customers to submit service requests to the Department over the Internet. In addition to entering a service request, customers can follow the status and progress of their request online. Complaint/request categories include: drainage; garbage/recycling/yard debris; code enforcement; sewer; and mosquitoes. The department provides site plan review status information online.

Emergency Preparedness
The mission statement for York County's Department of Fire and Life Safety is to provide protection and safety to our community in order to prevent emergencies when possible, and to respond quickly, minimize pain, suffering and loss when emergencies do occur. The Department includes the Office of Emergency Management with the responsibility to minimize the effects of a significant emergency or disaster through the coordination of a comprehensive, risk-based program of mitigation, preparedness, response, and recovery.

A comprehensive update to the County's Emergency Operations Plan (EOP) was completed in 2003 by the Office of Emergency Management. The plan is maintained on the internal web site for County employees. The County has a regular full-scale exercise program that is part of the radiological emergency preparedness program and, because there are some basic functions regardless of the emergency, the lessons learned serve an all-hazard purpose. The Department is responsible for maintaining an Emergency Operations Center (EOC) with all the essential materials and supplies to sustain an emergency response.

The following provides an overview of the mitigation activities implemented by the County's Department of Fire and Life Safety:

Warning

Emergency Alert System (EAS) is a national civil emergency alert system that uses message relays between member radio and television stations to inform the public about immediate threats to national security, life, and property. EAS is now routinely used for severe weather warnings and can also be employed to disseminate Amber Alerts for missing children. The enhancement is an initiative of Governor Warner's Secure Virginia Panel designed to improve statewide preparedness, response, and recovery capabilities for emergencies and disasters. Governor Mark R. Warner announced June 5, 2004, that Virginia will enhance its public warning capabilities with a new satellite-based system that can rapidly transmit EAS messages throughout the Commonwealth.

York County coordinates with Newport News Waterworks and Williamsburg Water to provide door-to-door notification to property owners in the inundation zone for the agencies' dams located in York County.

The County recently made arrangements with a radio station in Gloucester (WXGM 99.1 FM) to broadcast emergency information for York County throughout a disaster and the recovery phase. Due to the large broadcasting area on the Peninsula and Southside, and widespread damage throughout Hampton Roads after Hurricane Isabel, the media became overwhelmed and summarized emergency information for the smaller media markets leaving out details residents needed for recovery activities.

Neighborhood Emergency Information Distribution System (NEIDS) – Extended power outages during the 1998 ice storm resulted in a large number of remote-area residents without access to current disaster-related information. The York County staff created NEIDS to relay pertinent information to homeowners' association leaders in remote areas, with the expectation that these persons could further distribute the information to residents. The system was further refined after Hurricane Isabel, and pre-disaster meetings with community leaders help ensure that the system maintains its effectiveness despite changes in personnel at the County or community level.

Evacuation

In addition to the information provided above regarding the state's Evacuation Plan, County planners note that storm surge zones located in the eastern part of the County are heavily developed with mostly single-family residential units. Evacuation of such a large number of people onto Route 17 and north across the Coleman Bridge through low-lying Gloucester County and on into Fredericksburg, while maintaining emergency vehicle access to all parts of the County, is challenging.

Special Needs Program

As part of the enhanced 9-1-1 system, York County maintains a database of addresses for special needs residents. Residents voluntarily register for this service through the Department of Fire and Life Safety. Dispatcher's notify first responders that they are responding to a residence that has a special needs resident and describes the type of special need. The database is geo-referenced, and dispatchers can sort for special needs residents in specific geographic areas of the County to notify or warn them of potential hazards or to check on them during disasters. The County maintains a separate database of manufactured home parks.

Community Emergency Response Teams (CERT)

York County Department of Fire and Life Safety established CERT with the emphasis on building neighborhood teams. The purpose is to have neighborhoods and areas of the County better prepared and self-sufficient when disaster strikes. Currently the County is working with several neighborhoods to develop neighborhood emergency response plans and provide CERT training. The County has a neighborhood recognition program for those neighborhoods that organize CERTs and develop an emergency plan.

Other Mitigation Activities

In 2000, York County received Hazard Mitigation Grant Program funding of $7,937 to install impact resistant glazing in windows for the Emergency Operations Center and associated offices.

Following Hurricane Isabel, the County rigidly enforced the substantial damage regulations in the floodplain management ordinance, and approximately 35 structures were required to be elevated or demolished and rebuilt. Structures that were uninhabitable after Hurricane Isabel were able to make application for tax relief with the County. Each case was considered individually.

As a result of significant damage from flooding during Hurricane Isabel, the Yorktown waterfront is being substantially redeveloped, including work that was completed in FY2003 for the Riverwalk Landing Project. The $27 million project, overseen by the County's Office of Economic Development opened in spring of 2005. The project features a mix of retail shops and office space anchored by a restaurant. There is also a new parking structure and two public piers for private and commercial vessels. A substantial portion of the waterfront was elevated with fill, approximately four feet above previous grades, bringing it above the 100-year flood elevation.

Household Chemical Disposal is a special program, offered by the Virginia Peninsulas Public Service Authority, which provides an opportunity for York County residents to dispose of a variety of household chemicals and paint products including: gasoline, insecticides, paint, brake fluid, herbicides, solvents and cleaners. Collections take place one Saturday morning every other month. This program helps remove aging hazardous chemicals from residences throughout York County, including areas that could be affected by flooding.

Backup generator power is available to most critical facilities, i.e. fire stations, emergency operations center, emergency communications center, and the County's computer network servers. Limited backup generator power is available at one school serving as a shelter to provide lights and some cafeteria services in shelter area. All sanitary sewer stations have emergency generators and three of the four well facilities also have backup power. The County continues to replace the external breather tubes on the vacuum sewer system that is susceptible to flooding. The areas of Dandy and Seaford were shut down due to flooding during Hurricane Floyd. Dandy replacements are complete and most of Seaford is already complete.

York County's adopted Capital Improvements Program (CIP) for Fiscal Years 2005-2010 includes the following storm water projects:

- Greensprings Drainage Improvements – Design and construction of piping system to restore the ravine and other recommended improvements due to increased drainage causing erosion in the ravines.
- Cook Road/Falcon Road Drainage Improvements – To correct and stabilize a low-lying area with inadequate outfall drainage system to prevent flooding.
- Edgehill/Fort Eustis Drainage Improvements – This outfall drains part of Edgehill and adjacent properties towards Fort Eustis Boulevard and the Poquoson River. The majority of improvements will involve improvements to the roadside drainage and major outfall system.
- EllaTaylor/Gray Lane Drainage Improvements – To correct drainage pattern which was reversed during construction of commercial property on Route 17.
- Rich Acres/Route 17 Drainage Improvements – To correct inadequate drainage system.
- Terrebonne Drainage – To correct inadequate drainage system.

The CIP also includes projects to provide or improve water service to existing areas of the county, which enhances fire protection. Those areas of the County include:

Old Quaker Estates	Queens
Skimino Farms	Nelson Park
Burcher Road	York Terrace
Carver Gardens	Old Taylor Road

The CIP includes an emergency shelter survey proposed for FY2007. This project would provide for an evaluation of schools and various County buildings and their suitability for emergency operations and shelter use with safety and sustainability as the significant concern during major wind events.

5.6 State, Regional, and Federal Capabilities

The section below presents State, Regional, and Federal mitigation capabilities that are common to all communities within the Peninsula planning area.

STATE CAPABILITES

Virginia Department of Emergency Management (VDEM)
VDEM's Strategic Plan 2004-2013
This plan recognizes and prepares for Virginia's changing demographics and increasing threats over the next ten-year period. Goals, strategies and resources are built around the mission statement, which is "to protect the lives and property of Virginia's citizens from emergencies and disasters by coordinating the state's emergency preparedness, mitigation, response, and recovery efforts."

Commonwealth of Virginia Emergency Operations Plan (State EOP), April 2004
This plan consists of a Disaster Recovery Plan, a Hazard Mitigation Plan, and five hazard-specific volumes. The mitigation goals and project prioritization criteria from Section 4 of Virginia's Hazard Mitigation Plan are:

- Goal 1 - Structural Mitigation Projects - Maintenance of critical communication, transportation, or supply chain management operations, beneficial impacts for multiple agencies/organizations, feasibility, cost and funding, and multi-hazard mitigation;
- Goal 2 - Policy, Planning and Funding Human health and safety, preparedness, economic recovery, multi-hazard mitigation, and health care and shelter;
- Goal 3 - Information and Data Development - Human health, safety or economic stability, multi-hazard mitigation, beneficial impacts for multiple agencies/organizations, feasibility, and information quality and security; and,
- Goal 4 - Education and Outreach Activities – Number of people and property affected, beneficial impacts for multiple agencies/organization, multi-hazard mitigation, transferability and adaptability, and simplicity and consistency.

Virginia Emergency Alert Systems (EAS) Stations
Specific AM/FM radio stations provide updated disaster and directional information to listeners in the Commonwealth. Thirty-seven radio stations cover fourteen regions in Virginia, including: Eastern Virginia (2 FM stations), Southside (one AM station, one FM station), and the Richmond extended area (two AM stations, two FM stations), which provide coverage for the Peninsula planning area.

Virginia Department of Transportation
The Virginia Department of Transportation Phase 1 and Phase 2 evacuation routes are shown below and discussed online at http://www.virginiadot.org/comtravel/hurricane-evac-hro.asp. They are also available in local telephone directories. Due to the large population and limited number of highways leading out of Hampton Roads, phased evacuation using assigned routes is necessary.

Phase 1 evacuees from Hampton, Poquoson, Virginia Beach, Norfolk, and York County should evacuate 24 to 14 hours prior to the onset of tropical storm force winds. Phase 2 evacuees from Newport News, the remainder of Hampton, Chesapeake, Portsmouth and Suffolk should evacuate 14 hours prior to the onset of tropical storm force winds. The evacuation zones are shown in Figure 5.0.

Figure 5.6-Evacuation Zones

The Peninsula's emergency management officials are re-examining the existing evacuation routes in conjunction with new storm surge mapping (produced by VDEM, FEMA and the U.S. Army Corps of Engineers), existing topography, floodplains, new mapping, new traffic patterns and new development.

Virginia Department of Conservation and Recreation (VDCR)

Chesapeake Bay Regulations

As part of Virginia's commitment to help preserve and restore the resources of the Chesapeake Bay, the Virginia General Assembly adopted the Chesapeake Bay Preservation Act in 1988. The Chesapeake Bay Preservation Area Designation and Management Regulations were adopted in 1990 and amended in December 2001. The revised regulations took effect in March 2002 and localities had until December 31, 2003 to revise local ordinances and become consistent with the new language.

The regulations require that communities east of Interstate 95, the "Tidewater" area of Virginia, regulate and enforce the use of Resource Protection Areas (RPAs) and Resource Management Areas (RMAs). The RPA is relevant to floodplain management because new development within the designated area must maintain a 100-foot buffer from the waterline of any perennial stream, as defined by the regulations. This includes all tidal water bodies in coastal areas. Both the Hampton Roads Planning District Commission and the VDCR provide technical assistance and guidance to communities in enforcing the regulations. In essence, this is a staff regulation that strengthens local floodplain manager ordinances by exceeding minimum NFIP standards.

Virginia Flood Damage Reduction Act

Virginia's General Assembly enacted the Virginia Flood Damage Reduction Act of 1989. The legislation was the result of several disastrous floods and coastal storms that impacted the state between 1969 and 1985. To improve Virginia's flood protection programs and place related programs in one agency, responsibility for coordination of all state floodplain programs was transferred in 1987 from the Water Control Board to VDCR. The agency was named manager of the state's floodplain program and designated coordinating agency of the NFIP under the act.

Virginia Dam Safety Act

The Virginia Soil and Water Conservation Board established the state's dam safety regulations as a result of the passage of the Virginia Dam Safety Act. The Dam Safety Program's purpose is to provide for safe design, construction, operation and maintenance of dams to protect public safety. The program enforces permit requirements related to the construction and alteration of impounding structures. All dams in Virginia are subject to the Dam Safety Act unless specifically excluded. Inundation mapping is required for all Class I and Class II dams in the Commonwealth. Dam Safety Program officials recommend mapping for all classified dams. Emergency Action Plans are required for all class I, II, and III dams.

Shoreline Erosion Advisory Service (SEAS)

DCR's Shoreline Erosion Advisory Service promotes environmentally acceptable shoreline and riverbank erosion control measures to protect private property and reduce sediment and nutrient loads to the Chesapeake Bay and other waters of the Commonwealth. In addition, the program promotes research for improved shoreline management techniques to protect and enhance Virginia's shoreline resources.

Since SEAS was created in 1980, DCR has provided technical advice about tidal shoreline erosion problems to more than 7,000 clients. They include landowners, local governments and environmental agencies. SEAS program activities also help local governments deal with sediment and nutrient loads from shoreline erosion and, of course, address the Commonwealth's obligation to reduce sediment and nutrient loads in the Chesapeake Bay and its tributaries. For example, following Hurricane Isabel, SEAS provided technical assistance to the residents of Hampton's Chesapeake Avenue to facilitate reconstruction of a seawall spanning numerous property owners. The complexity of the project permitting and the number of property owners involved required external assistance.

Virginia Marine Resources Commission (VMRC)

The Virginia Marine Resources Commission was established in 1875 as the Virginia Fish Commission. The Virginia Wetlands Act was passed in 1972 and placed under the management of VMRC, as was the 1980 Coastal Primary Sand Dune Protection Act. In 1982, the General Assembly broadened the 1972 Wetlands Act to include non-vegetated wetlands. The Habitat Management Division issues three types of Environmental Permits: subaqueous or bottomlands, tidal wetlands, and coastal primary sand dunes. The division's authority specifically regulates physical encroachment into these valuable resource areas.

The permit process relies on a single Virginia joint local/state/Federal permit application. The review process takes into account various local, state and Federal statutes governing the disturbance or alteration of environmental resources. The Marine Resources Commission plays a central role as an information clearinghouse for all three levels of review. Applications receive independent yet concurrent review by the community's Wetlands Board, the VMRC, the Virginia Department of Environmental Quality, and the U.S. Army Corps of Engineers.

Department of Housing and Community Development

The Commonwealth of Virginia is responsible for enacting the Virginia Uniform Statewide Building Code (VUSBC), and each county or city is responsible for enforcing the code locally. As of the first quarter of 2005, the VUSBC is based on the 2000 International Building Code, International Plumbing Code, International Mechanical Code, and International Fire Protection Code, and the 1999 National Electrical Code. The 2003 version of the IBC has been incorporated into the VUSBC, and is expected to go into effect Fall, 2005. The code contains the building regulations that must be complied with when constructing a new building or structure or an addition to an existing building, maintaining or repairing an existing building, or renovating or changing the use of a building or structure.

Enforcement of the VUSBC is the responsibility of the local government's building inspections department. All Peninsula communities charge fees to defray the costs of enforcement and appeals arising from the application of the code. The VUSBC contains enforcement procedures that must be used by the enforcing agency.

As provided in the Uniform Statewide Building Code Law, Chapter 6 (36-97 et seq.) of Title 36 of the Code of Virginia, the USBC supersedes the building codes and regulations of the counties, municipalities and other political subdivisions and state agencies, related to any construction, reconstruction, alterations, conversion, repair or use of buildings and installation of equipment therein. The USBC does not supersede zoning ordinances or other land use controls that do not affect the manner of construction or materials to be used in the construction, alteration, or repair.

REGIONAL CAPABILITIES

The Hampton Roads Planning District Commission (HRPDC), one of 21 Planning District Commissions in the Commonwealth of Virginia, is a regional organization representing sixteen local governments, including Hampton, Newport News, Williamsburg, James City County and York County. Planning District Commissions are voluntary associations created in 1969 pursuant to the *Virginia Area Development Act* The purpose of planning district commissions, as set out in the Code of Virginia, Section 15.2-4207 is "…to encourage and facilitate local government cooperation and state-local cooperation in addressing on a regional basis problems of greater than local significance." The HRPDC serves as a resource of technical expertise to its member local governments. Specific programs affiliated with HRPDC include HR STORM/HR CLEAN, HREMC and REMTAC, which are described below.

HR STORM and HR CLEAN

Regional governments are developing and implementing stormwater management programs that include construction of best management practices (BMPs), system maintenance, water quality testing, enforcement of program standards and public education. Significant results and cost cuts are achieved through regional cooperation. These regional efforts are coordinated through HR

STORM, a coalition of local government staff members who share ideas and pool resources for targeted educational program efforts about stormwater management. In addition, the HRPDC facilitates monthly meetings of the Regional Stormwater Management Committee where program staff members from 14 localities in Hampton Roads coordinate efforts in water quality data gathering and pollutant loading studies. These data enable localities to better target future program dollars to improve management of stormwater quantity and quality. HR CLEAN is the recycling and litter prevention education program of the HRPDC.

Hampton Roads Emergency Management Committee (HREMC) - The objective of the HREMC is to promote the inter-jurisdictional and inter-agency coordination of emergency management issues and foster emergency preparedness in the Hampton Roads area, including the Peninsula communities. The purpose is to provide a working group for the exchange of information, experience and technology among Hampton Roads Emergency Management officials and individuals with responsibilities in emergency management. Participants include community officials, American Red Cross, military liaisons, State and Federal agency representatives, Verizon, Virginia Natural Gas and Dominion Power. Public information materials include *Is Your Family Prepared for Hurricanes*, a detailed family preparedness booklet focusing on Hampton Roads' procedures for evacuation and readiness.

Regional Emergency Management Technical Advisory Committee (REMTAC). This organizational, policy-making group is composed of HRPDC staff, Emergency Management staff in local communities, including the Peninsula, and VDEM staff. REMTAC works to enhance emergency management plans on a regional level. The HRPDC provides support to REMTAC and local jurisdictions on a variety of emergency management issues, including: hurricane evacuation planning; emergency shelter planning; debris management resource planning; disaster planning for populations with special needs and public education awareness and hurricane preparedness programs. REMTAC members have access to a secure online forum among registered participants, in addition to monthly meetings.

Surry Power Station Emergency Public Information – Surry Power Station, located on the James River aboutseven miles south of Williamsburg, can generate 1,625 megawatts of electric power from its two nuclear reactors. Surry is linked to the Dominion Virginia Power transmission portfolio servicing the Peninsula. Although the power station would not normally be included in natural hazard mitigation planning, the facility represents a noteworthy manmade hazard and area emergency management plans pay considerable attention to the siren warning system. Cities and counties in the Surry Power Station Planning Area include: James City County, York County, Newport News, Williamsburg, Isle of Wight County, and Surry County. The Peninsula communities exclude all other hazard siren systems to avoid confusion over multiple siren tones and signals in the region.

FEDERAL CAPABILITES

The National Flood Insurance Program (NFIP)

Established in 1968, the NFIP provides flood insurance in communities that agree to regulate new development in identified Special Flood Hazard Areas through the adoption and enforcement of a minimum Flood Damage Prevention Ordinance. The program also requires, as a condition of every Federally-backed mortgage within an identified Special Flood Hazard Area, the purchase and maintenance of a flood insurance policy for the life of the loan.

The Coastal Barrier Resources Act (CoBRA)
Established in 1972, the CoBRA is environmental legislation administered by the U.S. Fish and Wildlife Service. The legislation provides for the identification and protection of Coastal Barrier Resources. The act further prohibits the availability of Federally-backed assistance within identified areas, including grants, loans, mortgages and Federal flood insurance. For the Peninsula communities, only the City of Hampton has areas designated as part of the Coastal Barrier Resource System (Units VA-60 and VA-60P).

Coastal Zone Management Act (CZMA)
Established in 1972, and amended by the Coastal Zone Protection Act of 1996, the CZMA defines a national interest in the effective management, beneficial use, protection and development of the coastal zone and identifies the urgent need to protect the natural system from these competing interests.

VDEQ oversees the Virginia Coastal Resources Management Program, established to protect and manage an area know as Virginia's "coastal zone." All five of the Peninsula communities are located in the coastal zone. The program has produced a large number of publications and assisted in the development of numerous projects to support their nine primary goals, available online at http://www.deq.virginia.gov/coastal/goals.html.

Examples of the program's accomplishments impacting the Peninsula include:

- Coastal Dune Resources Inventory - Virginia has coastal dune resources on about 48 miles of shoreline. An inventory, now underway by the Virginia Institute of Marine Science, is part of an ongoing Virginia Coastal Program effort to establish a better understanding of dune systems, including primary, secondary, coastal and riverine dunes, in coastal Virginia. The inventory includes where dunes are located, how they should be defined, and how they function in the natural environment. The goal is improved management to ensure that both the habitat and flood protection benefits derived from these naturally occurring and rare systems are maintained.
- Riparian Buffer Sign Program - The Virginia Coastal Program designed a riparian buffer sign to emphasize the importance of riparian buffer restoration in the coastal watershed. The sign, available to all groups and organizations planting buffers in Virginia's coastal zone, links buffer restoration sites throughout Tidewater Virginia, providing the public with a consistent message on the benefits of riparian buffers. At York River State Park, a new buffer, planted on a steep denuded slope, protects the park's marsh and the York River beyond.
- Statistical analysis of the impact of channelization activities and dams in Tidewater Virginia on instream and riparian habitat.

- Virginia Clean Marina Program (VCMP) - In 2001, marina operators, marine industry representatives and state officials launched the program, which is a voluntary initiative designed to educate and give technical support and special recognition to marinas that implement BMP's that go above and beyond regulatory requirements, minimizing potentially negative impacts on water quality and coastal resources. Clean Marinas on the Peninsula include: Hampton Public Piers, Old Point Comfort Marina at Fort Monroe; Salt Ponds Marina in Hampton, Two Rivers Yacht Club in Williamsburg; and Wormley Creek Marina in Yorktown.

- Wetland Educational Materials - The Virginia Institute of Marine Science, College of William and Mary, with Coastal Program funding, has developed legal and educational materials that are being used by all local wetlands boards. VIMS also produces a Wetlands Newsletter and holds regular workshops and seminars for board members, local governments and others interested in wetland management.

6.0 Mitigation Goals and Objectives

Sections 4.1 through 4.5 document the risks from and vulnerabilities to the natural hazards that threaten the Virginia Peninsula communities. Section 5.1 through 5.5 provides more detailed information describing vulnerability and capacity on a community-by-community basis. With this information the PHMPC could now begin to formulate mitigation planning goals. The intent of the Goal Setting process is to identify areas where improvements to existing capabilities can be made so that community vulnerability is reduced.

Before formulating the goals for this plan, the PHMPC first reviewed planning goals in general. Each PHMPC member was provided a written and graphic explanation of Goals and Objectives, the purpose they serve and how they are developed and written. Following this activity, each PHMPC member was provided with an alphabetized list of 14 sample goal statements. Some of these goals were from existing community plans, some were developed as a result of analyzing the Risk Assessment, and some were generic community planning goals, such as “Improve Public Safety Services.”

The PHMPC participated in a discussion of the sample goal statements, and developed an understanding of the relationship of plan goals and objectives to the recommended actions that they would later be tasked to formulate. Following this discussion, each PHMPC member received three index cards and was asked to write what they felt would be the most appropriate goals for this plan --- one on each card --- using the possible goal statements as a guide.

PHMPC members were instructed that they could use, combine or revise the sample statements or develop entirely new goals. Team members then posted their cards to the meeting room wall, and the goal statements were placed into similar groups, combined, rewritten and agreed upon. Upon group review, some of the proposed goal statements were determined to be better suited as objectives or actual mitigation projects – and were set aside for later use.

Based upon the planning data review and the process described above, the PHMPC developed the final goal statements listed below. None of the final goal statements are the same as those provided on the alphabetized list. These goals and objectives (and occasional action item) provide direction for reducing future hazard-related losses for the Peninsula communities.

GOAL 1: Reduce impacts and losses from natural hazards

Objective 1.1: Strengthen community Emergency Management programs

- Maintain each community’s all- hazards Emergency Operations Plan (EOP) to support and promote Public Safety
  - ✓ Establish and maintain ability to coordinate with the public in disasters
- Provide Disaster Recovery Training for employees and volunteers
- Initiate, coordinate and support Business Continuity/Contingency planning

- Achieve and maintain National Weather Service "Storm Ready" Certification
- Establish and maintain baseline information resource systems (GIS)

Objective 1.2: Minimize exposure of existing development from likely hazard impacts

- Protect at-risk critical facilities
- Implement and maintain existing hazard loss reduction programs
- Mitigate repetitive hazard-related losses

Objective 1.3: Minimize exposure of new development to likely hazard impacts

- Integrate Mitigation Planning into each community's Comprehensive Planning program
- Enforce/enhance floodplain and zoning regulations or limitations in vulnerable areas, as appropriate

Objective 1.4: Strengthen community Floodplain Management programs

- Coordinate and maintain local floodplain management ordinances with the Virginia Uniform Statewide Building Code
- Address repetitive flood losses
- Participate in the NFIP's Community Rating System, as appropriate

<u>GOAL 2:</u> Promote awareness of hazards and vulnerability among citizens, business, industry and government

Objective 2.1: Develop a seasonal multi-hazard public education campaign to be implemented annually

- Hurricanes and coastal storms, flooding, tornados, winter storms and wildfires
- Flood Insurance
  - ✓ Availability, Coverage, Floodplain Management, the "50 percent" rule (and impact of inflation, market versus assessed value, and ICC)
- Business Continuity/Contingency planning
- Self-help guidance

<u>GOAL 3:</u> Maximize use of available funding

Objective 3.1: Maintain FEMA Eligibility

Objective 3.2: Identify, analyze and establish Mitigation project cost share options

- Multi-Objective Opportunities
  - ✓ Public/Private Partnerships
  - ✓ Coordination with other community goals, programs and projects
    - Housing Transportation, Recreation, Stormwater Management
- Community contributions

- ✓ Cash (grants, budgeted)
- ✓ In-Kind
- Property Owner Contributions

6.1 Review of Mitigation Alternatives

In a separate PHMPC meeting, the Planning Team undertook a brainstorming session to generate a set of viable mitigation alternatives that would support the above goals. To begin this process, each PHMPC member was provided with the following list of categories of mitigation measures:

- Prevention,
- Property Protection,
- Structural Projects,
- Natural Resource Protection,
- Emergency Services, and
- Public Information.

The PHMPC members were also provided with lists of alternative multi-hazard mitigation actions for each of the above categories. Below is an example of the list the PHMPC examined for the category of Property Protection. A facilitated discussion then took place to examine, understand and analyze the alternatives. The complete listing of alternatives reviewed and discussed is included in Appendix G**.**

PROPERTY PROTECTION: Property protection measures are used to modify buildings subject to damage rather than to keep the hazard away. A community may find these to be inexpensive measures because often they are implemented by or cost-shared with property owners. Many of the measures do not affect the appearance or use of a building, which makes them particularly appropriate for historical sites and landmarks.

- ***Retrofitting/disaster proofing***
  - ***Floods***
    - Wet/Dry floodproofing (barriers, shields, backflow valves)
    - Relocation/Elevation
    - Acquisition
    - Retrofitting
  - ***High Winds/Tornados***
    - Safe Rooms
    - Securing roofs and foundations with fasteners and tie-downs
    - Strengthening garage doors and other large openings
  - ***Winter Storms***
    - Immediate snow/ice removal from roofs, tree limbs
    - "Living" snow fences
  - ***Geologic Hazards (landslides and earthquakes)***
    - Anchoring, bracing, shear walls
    - Dewatering sites, agricultural practices
  - ***Drought***
    - Improve water supply (transport/storage/conservation)
    - Remove moisture competitive plants (Tamarisk/Salt Cedar)
    - Water Restrictions/Water Saver Sprinklers/Appliances
    - Grazing on CRP lands (no overgrazing-see Noxious Weeds)
    - Create incentives to consolidate/connect water services
    - Recycled wastewater on golf courses
  - ***Wildfire, Grassfires***
    - Replacing building components with fireproof materials
      - Roofing, screening
    - Create "Defensible Space"
    - Installing spark arrestors
    - Fuels Modification
  - ***Noxious Weeds/Insects***
    - Mowing
    - Spraying
    - Replacement planting
    - Stop overgrazing
    - Introduce natural predators
- ***Insurance***

6.1.1 Using Criteria to Analyze and Select Mitigation Measures

The PHMPC participated in a second facilitated discussion that took place to examine and analyze the alternatives, using FEMA's recommended STAPLE/E decision-making criteria, in addition to STAPLE/E, Sustainable Disaster Recovery, Smart Growth principles, and "Others". This was done to determine why one recommended action might be more important, more effective, or more likely to be implemented than another (a complete list of criteria examined is included in Appendix H).

STAPLE/E Criteria Set

Social:	Does the measure treat people fairly? (different groups, different generations)
Technical:	Will it work? (Does it solve the problem? Is it feasible?)
Administrative:	Do you have the capacity to implement & manage project?
Political:	Who are the stakeholders? Did they get to participate? Is there public support? Is political leadership willing to support?
Legal:	Does your organization have the authority to implement? Is it legal? Are there liability implications?
Economic:	Is it cost-beneficial? Is there funding? Does it contribute to the local economy or economic development?
Environmental:	Does it comply with Environmental regulations?

The PHMPC listed all of the hazards posing a threat to the community and then generated their preferred set of mitigation measures per hazard, using the criteria to determine the most suitable proposals. The proposed actions were recorded on easel pads and then posted to the wall for review, comment, and fuller development of the recommendation.

6.1.2 Reaching Consensus by Prioritizing Mitigation Measures

After selecting the mitigation measures, the recommended actions were posted on the wall and all Committee members were provided with nine colored dots of which there were three each of blue, red, and yellow. Each color represents high, medium, or low priority with regard to importance, and each color was assigned a corresponding value:

Blue = 5 points
Red = 3 points
Yellow = 1 point

Committee members then voted for their preferred mitigation measures by placing their dots on the hazard specific recommendations. Team members were allowed to place as many of any or all colors on any one recommendation or to spread them among multiple mitigation actions. They were allowed to trade dots, or otherwise negotiate with any other team member, and were not required to use all of their dots if they so chose. This process provided both consensus and priority for the Committee recommendations. Throughout the process, each Committee member was reminded that there would be time to discuss and revise each idea further through the scheduled team review, public input, and process of developing three drafts of this plan before submittal for review and adoption.

The table below shows how the Committee prioritized the mitigation measures with "dot points".

Table 6.1.2a- Committee Voting Results on Mitigation Measures

Categories of Mitigation Measures	Hampton	Newport News	Williamsburg	York County	James City County
Community Rating System	20				
Address Repetitive Losses	12				
Shoreline Erosion Reduction	9				
Refurbish Existing Seawall	2				
Drainage Improvements/Maintenance	13	37		7	
Elevate Flood-Prone Structures	1	18			0
Generator Wiring of Critical Facilities	1	32		35	
Public Notification System	0		5		
Relocate Critical Facilities	3				
Evaluate Existing Floodplain Mgmt	29			10	10
Open Space Protection	1			16	
Stormwater Management	3		3	19	5
Training Employees & Students	11	33			
Public Information	3				
Hazard Information Pack for New Homebuyers	2				
BFE plus 2 feet	15	25		8	
Small Business Contingency Planning		8			3
Elevation Certificate availability		12			
Shelter Management		17		1	
Water Conservation Programs		14			2
Forest/Wildfire Management		11	6		
Anti-Gouging Ordinance		14			
Moratorium for Codes Compliance		2			
Strengthen Land Development Regulations				58	5
Improve Neighborhood Communication					5
Floodproofing Measures					1
Examine/promote Bldg Codes					10
Underground Utilities Program			1		

The list of recommended mitigation measures distributed across the Categories of Measures in the following way:

Table 6.1.2b- Mitigation Measures Prioritized

Categories of Mitigation Measures	Hampton	Newport News	Williamsburg	York County	James City County
Emergency Services	1	65	5	36	5
Property Protection	16	26	1	0	4
Prevention	44	37	0	76	25
Public Information	36	33	0	0	0
Structural Projects	18	37	3	26	5
Natural Resource Protection	10	25	6	16	2

6.1.3 Action Plan

The results of the planning process, the risk assessment, the mitigation strategy, and the hard work of the Committee are presented below. This action plan presents the prioritized recommendations for the Peninsula communities to pursue in order to lessen the vulnerability of people, property, infrastructure, and natural and cultural resources to future disaster losses.

6.2 The Mitigation Strategy

Within the Virginia Lower Peninsula Planning Area, five communities participated on the PHMPC and provided valuable data and insight into this plan. While different in their boundaries, form and function, each recognizes their role to prepare for disaster, respond to natural hazards and undertake mitigation initiatives. Each, however, is part of the larger regional community that must prepare for and respond to a similar set of hazards. Thus, there is a "mosaic" of partners and these relationships define the overall hazard mitigation planning strategy.

The PHMPC has developed the following four mitigation strategies:

- **ENFORCE** existing rules, regulations, policies and procedures already in existence. Communities can reduce future losses not only by pursuing new programs and projects, but also by more stringent attention to what's already "on the books",
- **EDUCATE** the public using the hazard information that the PHMPC has collected and analyzed through this planning process so that the community better understands what can happen where, and what they can do themselves to be better prepared. Also, publicize the "success stories" that are achieved through each community's ongoing efforts,
- **IMPLEMENT** this Mitigation Action Plan, and
- **MOM** - monitor Multi-Objective Management opportunities, so that funding opportunities may be shared and "packaged" and broad constituent support is gained.

6.3 Peninsula Mitigation Recommendations

In this section, the PHMPC offers proposed mitigation actions in the form of recommendations. The recommendations that follow are those that would have a beneficial impact upon the community referenced; the schedules and cost estimates are not binding and do not imply that the community must complete each action. These recommendations are made with the knowledge and consent of the entire PHMPC by virtue of the formal adoptions of this plan (Appendix I). Thus, each participating community has identifiable "projects" in this plan. Table 6.1.4 provides a summary of the goals and objectives addressed by each Action Item. Please note that each community has recommended actions that reinforce their commitment to ensuring ongoing compliance with NFIP requirements.

Table 6.3 - Categorizing Action Items by Goal and Objective

	Hampton	Newport News	Williamsburg	York County	James City County
Goal 1: Reduce impacts and losses from natural hazards					
1.1 – Strengthen community Emergency Management	1,2,5, 6,9,10	1,3,5,7, 8,9,11	1,2,4, 5, 8	4,8,9,10,11	8
1.2 – Minimize exposure of existing development	2,3,4,5, 6,7,8,12	3,4,5,6, 8,9,10, 12	3,4,1,6,7,8,9	1,2,3,4,6, 9,10,11,12,13	1,2
1.3 – Minimize exposure of new development	10,11	6,10	3,8	1,2,5,6,7	3,5
1.4 – Strengthen community Floodplain Management	1,2,8,9	2,4,6,11	6,9	1,2,5, 6,12,13	1,2,3,5
Goal 2: Promote awareness of hazards & vulnerability					
2.1 – Develop multi-hazard public awareness campaign	1,10	5,7, 8,10,11	2,3,5,7,8	8,9,10,11	4,6,7
Goal 3: Maximize use of available funding					
3.1 – Maintain FEMA eligibility		2,6		1,6,7	3
3.2 – Identify, analyze and establish cost-share options	2,3,5, 6,8,11	4,8,12	3,,8	4,10,12,13	1,7

6.3.1 Hampton Mitigation Recommendations

Recommended Action Item #1: Enroll Hampton in the Community Rating System (CRS). Prepare outreach materials to include: flood insurance availability; retrofitting existing structures; and hazards packet for new homeowners.

Issue/ Background: Hampton has numerous structures in the 100-year floodplain (11,491), a large number of NFIP policies (9,792), and a large number of repetitive losses (160). CRS provides a structured incentive program to address flood hazards by rewarding policyholders with premium discounts, enhancing public safety, reducing damage to property and public infrastructure, avoiding economic disruption and losses, reducing human suffering, and protecting the environment.

Other Alternatives Considered: No action with regard to the CRS and NFIP Public Outreach is expected to result in increasing losses, and rising NFIP total premiums paid. Public outreach without CRS participation may not be as effective at reducing flood risk because policyholders would not experience any premium savings.

Responsible Office: Office of Emergency Management and Floodplain Management.

Priority (H, M, L): High

Cost Estimate: Application submittal is free if completed by City staff. Additional hours required for annual reviews, and re-application every five years.

Cost Benefit: All of Hampton's 9,792 NFIP policyholders would benefit from the CRS premium savings, resulting in approximately $219,000 annual savings (5 percent annual savings for each individual policy) for a Class 9 rating. A Class 8 rating results in almost $440,000 annual savings.

Potential Funding: Existing budgets.

Schedule: Submit CRS application within 6 months of plan adoption.

Recommended Action Item #2: Prepare Repetitive Loss Plan

Issue/ Background: Prioritize actions to assist in the rebuild and protection of structures with Repetitive Flood Losses. Nationwide, 30 percent of all NFIP payouts go to approximately one percent of policy- holders. Handling these structures first so that they are less likely to have repeat damage during future flood events should provide long-term benefits to the homeowner, community, and the NFIP. Fewer claims should eventually result in better mapping, improved technical assistance, and lower premiums. Additionally, because reducing the number of repetitive losses is a priority, the availability of funding to support this activity is more prevalent.

As a subset to the activity, an analysis of the 15 post-firm Repetitive Loses should be developed to better understand and correct this unusual situation.

Other Alternatives Considered: If the City does not take any action to address the large number of repetitive flood losses, the losses can be expected to increase.

Hampton is considering joining the Community Rating System, and with greater than 10 repetitive losses, development of a Repetitive Loss Plan is mandatory.

Responsible Office: Codes Compliance and Floodplain Management.

Priority (H, M, L): High

Cost Estimate: Staff time

Cost Benefit: The cost of staff time to develop a repetitive loss plan will result in savings being achieved by property owners, the community, and NFIP through CRS.

Potential Funding: FMA, existing budgets.

Schedule: Immediately

Recommended Action Item #3: Elevate flood-prone homes

Issue/ Background: Reduce property damage from repetitive flooding by elevating homes in flood-prone areas of the city that meet criteria of the elevation program.

Other Alternatives Considered: Relocation of flood-prone structures was considered, but Hampton is relatively built-out and the floodplain area is extensive. The number of developable lots out of the flood hazard area is minimal. Acquisition has been implemented in some cases, depending on condition of the structure, floor risk, and homeowner needs.

Responsible Office: Codes Compliance, Procurement, Public Works, Floodplain Management.

Priority (H, M, L): High

Cost Estimate: $40,000 - $60,000 per home

Cost Benefit: Average annual damages are substantially reduced when structures are elevated one foot above the Base Flood Elevation.

Potential Funding: HMGP, PDM, FMA, CDBG, USACE, and Virginia Department of Housing and Community Development Disaster Recovery Fund.

Schedule: A project to elevate approximately 21 homes has been approved by FEMA and implementation will begin in 2005. Elevation of flood-prone homes will be an ongoing strategy for the City.

Recommended Action Item #4: Relocation of Hampton City Schools Maintenance Facility out of repetitive flood area.

Issue/ Background: Relocate city schools maintenance operations to a facility outside 100-year floodplain. Facility is repetitively flooded and flooding damages important maintenance equipment.

Other Alternatives Considered: Elevation of the facility is not an option due to the size, the equipment needing to be housed, and the nature of the flood hazard. No action does not solve the flood problem.

Responsible Office: Office of Emergency Management, Hampton City Schools, NFIP Administrator

Priority (H, M, L): High

Cost Estimate: $300,000

Cost Benefit: Relocation would reduce average annual damages to the facility and equipment. Reduce labor and insurance costs, as well.

Potential Funding: HMGP, PDM, FMA, USACE, Tidewater, Soil Conservation Service Urban Programs or Floodplain programs, existing City and School Board capital improvement funds

Schedule: HMGP application submitted to FEMA in 2003. Grant denied. Future funding opportunities will determine schedule to complete this item.

Recommended Action Item #5: Develop storm-resistant beach along Hampton waterfront from Grandview to Fort Monroe. Integrate beach profile with existing hard structures.

Issue/ Background: Reduce beach erosion and property damage from storms affecting the Chesapeake Bay and waterfront in Hampton.

Other Alternatives Considered: No action will result in continued property damage from storms. Coastal armoring, such as seawalls, groins and jetties already exist in the area; additional hard structures can transfer problems to adjacent areas.

Responsible Office: Floodplain Management, Office of Emergency Management

Priority (H, M, L): High

Cost Estimate: $3,500,000

Cost Benefit: Study and develop "engineered" beach the length of Hampton's Chesapeake Bay waterfront to tie in existing areas of beach projects with new project to reduce the impact of storms on waterfront areas. Salt Ponds, Buckroe and Grandview neighborhoods would benefit. Reduced damage to roads and other infrastructure result in safer and quicker evacuation and emergency response, and faster return to normalcy after a storm event.

Potential Funding: HMGP, USACE, HRPDC Coastal Resources Technical Assistance Program, Tidewater Soil Conservation Service, existing city capital improvement funds.

Schedule: HMGP application submitted to FEMA in 2003. Grant denied. Future funding opportunities will determine schedule to complete this item.

Recommended Action Item #6: Public Notification/Warning System

Issue/ Background: Provide public notification of threats, hazards and emergency information. Allows remote hazard identification. Implementation will necessitate public education component and extensive staff training.

Other Alternatives Considered: No action alternative considered; homeowners would be provided only limited information as in the past.

Responsible Office: Office of Emergency Management

Priority (H, M, L): High

Cost Estimate: $100,000

Cost Benefit: Procure, install and maintain public notification system. Provide time for residents to prepare for storms, evacuate lower floors, and reduce damage from storm events.

Potential Funding: HMPG, FMA, DHS grants, USACE

Schedule: HMGP application submitted to FEMA in 2003. Grant denied. Future funding opportunities will determine schedule to complete this item.

Recommended Action Item #7: Wiring of critical facilities for generator quick hookup.

Issue/ Background: Wire existing shelters and critical facilities to use generator power in the event of power outages during emergencies. Currently, shelters without power are not climate controlled and food spoilage is problematic. Approximately 20 facilities and pump stations will be pre-wired for generator power.

Responsible Office: Office of Emergency Management, Hampton City Schools

Priority (H, M, L): High

Cost Estimate: $25,000 per facility, total $500,000

Cost Benefit: Providing ability to contract for and install backup generator power to shelters during emergencies decreases direct damages incurred by the School Division due to food spoilage, and decreases shelter management costs by allowing onsite food preparation.

Potential Funding: HMGP, VDEM, post-disaster Virginia Fire Programs Emergency Fund loans, existing capital budgets, other grant opportunities.

Schedule: HMGP Application submitted to FEMA in 2003. Grant denied. Future funding opportunities will determine schedule to complete this item.

Recommended Action Item #8: Re-evaluate existing regulations/programs with regard to strengthening overall approach to floodplain management.

Issue/ Background: Hampton's current floodplain management ordinance is a model ordinance, adopted at the recommendation of the Virginia Department of Conservation and Recreation. It meets, but does not exceed, the FEMA minimum requirements. City officials should consider measures that exceed NFIP minimums to help reduce flooding risk to new development, and examine overall program of recordkeeping and ordinance enforcement to ensure ongoing compliance with NFIP requirements. The City should consider the following changes to ordinance and development procedures: 1) Adopt two feet freeboard requirement above BFE for A Zones and V Zones (BFE + 2 feet); 2) Include Emergency Management comments in site plan review process; 3) Streamline process for collecting and maintaining Elevation Certificates for new and substantially improved structures in the 100-year floodplain (NFIP requirement); 4) Review all handouts, forms, and checklists provided to developers for site plan review and building permits to ensure consideration of flood hazards; and 5) Develop standardized form for making substantial damage determinations. The City should incorporate floodplain and emergency management into early project and site plan review. Two feet freeboard would provide better protection for structures, flood insurance premium savings, and points under the Community Rating System.

Responsible Office: Codes Compliance, Planning, Emergency Management

Priority (H, M, L): High

Cost Estimate: Minimal staff time to educate Council members and the public. There is a cost to builders to elevate structures an additional two feet and thus, a likely "pass-on" cost to prospective purchasers of those structures. Additional Emergency Management staff time required for review and comment on site plans.

Cost Benefit: Measures that exceed NFIP minimums help reduce flood insurance premiums, and protect structures from floods that exceed the 100-year flood. New development in the floodplain has lower average annual damages if elevated above BFE. Points from CRS also would provide additional savings to policyholders.

Potential Funding: HRPDC Coastal Resources Technical Assistance Program, Virginia Department of Conservation and Recreation Floodplain Management staff assistance, existing budgets.

Schedule: Within one year of plan adoption.

Recommended Action Item #9: Provide training and public education materials to school personnel and school children regarding characteristics of local hazards, mitigative actions, and emergency response.

Issue/ Background: Extensive storm surge area in Hampton exposes a large proportion of the population to flood hazards, whether at school, work or home. The City needs volunteers to help manage post-disaster scenarios, including tasks such as reporting post-event conditions to the EOC, serving as a means of communication throughout the neighborhoods, and traffic control.

Other Alternatives Considered: The No Action scenario does not increase awareness or provide volunteer workforce in post-disaster situation. Out of town contract labor after disasters is expensive and slower to respond than volunteers.

Responsible Office: Office of Emergency Management

Priority (H, M, L): Medium

Cost Estimate: $50,000

Cost Benefit: School personnel and school children learn disaster preparedness techniques, thereby minimizing evacuation times and protecting life and safety. Volunteer workforce can quickly respond to disasters and reduce additional post-disaster damage and injuries.

Potential Funding: Chesapeake Bay Restoration Fund (for conservation/restoration related educational aspects), HRPDC Coastal Resources Technical Assistance Program, VDEM, existing budgets

Schedule: Within two years of plan adoption.

Recommended Action Item #10: Preserve open space through floodplain park development.

Issue/ Background: Hampton has a citywide history of flooding. Strategic Investment Area Master Plans have identified particular parcels as suitable for parks or recreation areas. Limited acquisition of structures may be necessary to facilitate open space preservation of suitable flood-prone lands as recreation or park areas.

Other Alternatives Considered: No action to preserve or create open space in the floodplain may result in residential or commercial development of these sensitive areas.

Responsible Office: City Parks and Recreation, City Planning Department

Priority (H, M, L): Medium

Cost Estimate: $1,200,000

Cost Benefit: Parks and recreation planning in conjunction with floodplain management satisfies multi-purpose goals. Flooding of both existing and proposed developments is mitigated. CRS points available for this activity.

Potential Funding: Chesapeake Bay Restoration Fund, City of Hampton Redevelopment Funds, Virginia Land Conservation Foundation, Virginia Outdoors Fund Grant Program, Virginia Recreational Trails Fund Program, HMGP, PDM, FMA, CDBG

Schedule: Within three years of plan adoption. Zoning designations and Comprehensive Plan elements could be implemented faster at no cost in order to provide the framework for future projects and priorities.

Recommended Action Item #11: Implement Drainage Improvement Projects to protect against blockage.

Issue/ Background: Many culverts in the city are inadequately sized for increased runoff resulting from recent development.

Other Alternatives Considered: No action will result in continued urban and nuisance flooding, and possibly repetitive flood losses. Channel modification, while seemingly sufficient, does little to alleviate flood flows in the region.

Responsible Office: Department of Public Works, Engineering Services

Priority (H, M, L): Low

Cost Estimate: $75,000 per year

Cost Benefit: By maintaining culverts and protecting against blockages, flood flows are attenuated more quickly and nuisance flooding reduced. Average annual damages to structures and infrastructure are also reduced.

Potential Funding: Capital Improvement Plan, Tidewater Soil Conservation Service

Schedule: Within five years of plan adoption.

6.3.2 Newport News Mitigation Recommendations

Recommended Action Item #1: Adopt ordinance to prevent price gouging after a disaster.

Issue/ Background: After Hurricane Isabel, various vendors and contractors doubled and tripled their standard service prices.

Other Alternatives Considered: No action will allow price gouging to continue. Public education regarding contractor requirements/credentials considered, but statutory changes deemed most effective.

Responsible Office: Codes Compliance, Intergovernmental/Community Relations

Priority (H, M, L): High

Cost Estimate: Minimal cost; staff time only.

Cost Benefit: Property owners save money and can reinvest those funds into protecting property from future damage.

Potential Funding: Existing budgets.

Schedule: Immediately.

Recommended Action Item #2: Increase accessibility to digital Elevation Certificate data.

Issue/ Background: Currently, Elevation Certificate data are collected and entered into the city's computer system, but the data cannot be retrieved. The City is committed to ensuring ongoing compliance with NFIP requirements.

Other Alternatives Considered: Paper copies are bulky and do not last as long as digital data. No Action would result in continued problems accessing data for other floodplain management purposes.

Responsible Office: Plans Examiner, Codes Compliance, Information Technology, Department of Engineering

Priority (H, M, L): High

Cost Estimate: Minimal cost for staff time to reconfigure database access.

Cost Benefit: Sharing of this data will increase opportunities for mitigation projects, and provide emergency and land us planners with a useful floodplain management tool at minimal cost. CRS points available for this activity.

Potential Funding: Existing budgets

Schedule: Immediately

Recommended Action Item #3: Retrofit primary shelters, which are certified by the American Red Cross, with generator hookups.

Issue/ Background: Public schools in Newport News do not have generator power outside of emergency lighting. During storm events, this has been a concern especially when special populations are concerned. The City had to rent hotel rooms for special populations during Hurricane Floyd. During Hurricane Isabel, the shelters were left without power.

Other Alternatives Considered: No action alternative does not address the problem. Building new schools with full capacity generators is not financially feasible. Simply not opening shelters and forcing evacuation is not an option for the isolated Peninsula area.

Responsible Office: Office of Emergency Management, Department of Engineering and American Red Cross

Priority (H, M, L): High

Cost Estimate: $750,000

Cost Benefit: Special populations can be accommodated at shelters, rather than hotels, and shelters will be better equipped to feed and house all City residents.

Potential Funding: FEMA Hazard Mitigation Grant Program funds 75 percent and City funds 25 percent; PDM; Homeland Security

Schedule: Implementation during 2006.

Recommended Action Item #4: Continued implementation of Flood Assistance Program (FAP), primarily through flood-prone structure acquisition.

Issue/ Background: In response to continued requests for solutions to the persistent flooding of properties in its low-lying areas, the City of Newport News established a voluntary Flood Assistance Program in 1999. The program was designed to aid property owners with structures located in the 100-year floodplain. The goals of the FAP are to reduce or eliminate flood-associated losses, reduce flood insurance costs, and restore wetlands and greenspace. Acquisition of homes is a priority. Future plans for acquired areas include park uses in the regulatory floodway.

Other Alternatives Considered: Other options explored by the City included floodwalls and levees. The expense of installation and regular maintenance, plus the previous flood damage to many area homes, made these options less feasible than an assistance program. The City determined the appropriate solution involved returning the properties to wetlands and greenspace.

Responsible Office: Department of Engineering

Priority (H, M, L): High

Cost Estimate: $200,000 annual City funding, plus any grant funding that may become available. Program can be expanded based on available funds.

Cost Benefit: For areas prone to repeated flooding, acquisition of homes offers a permanent solution. The families, who have endured repetitive flooding, are given a new start and are forever removed from flood harm. Also, local emergency management crews are no longer required to rescue these residents during dangerous storm or flood events. CRS points available for this activity.

Potential Funding: Annual allocation from the Stormwater Fund Balance. Program costs include fees associated with appraisal/inspection, legal/closing, replacement housing, moving, property security and demolition. Additional funding through HMGP, PDM and FMA will be used, as available.

Schedule: Ongoing. The program includes a 60-day application period each year. A Flood Assistance Program Committee then convenes to review ranked, eligible properties. The Committee makes the final decision for the use of fiscal year funding each year. To date, about thirty homes have been acquired through the FAP.

Recommended Action Item #5: Continue forest management program to mitigate wildfire hazards and promote health of forests within the City's reservoir watersheds.

Issue/ Background: The Newport News Department of Public Utilities (Waterworks) has maintained a comprehensive forest management program for over 20 years. The program includes fire trails, clear-cutting, thinning, disease control and other elements to maintain healthy forests. The program works in conjunction with a Newport News Watershed Protection ordinance.

Other Alternatives Considered: Funding could be increased to the program to provide additional staff for program enhancements. Some aspects of the program could be contracted to outside sources. At the present time, these alternatives were rejected in favor of maintaining the program's status quo as the program has been effective.

Responsible Office: Newport News Waterworks, Chief of Forest Resources

Priority (H, M, L): High

Cost Estimate: Estimated $1,000,000, annually.

Cost Benefit: The forest program's main objective is water quality protection, and it helps maintain the quality of the City's existing raw water sources.

Potential Funding: City's Annual Operating Budget, US Forest Service, Virginia Department of Forestry

Schedule: Ongoing.

Recommended Action Item #6: Review floodplain management ordinance and enact new requirements based on local conditions. Adopt an ordinance requirement for floodplain structure elevation to Base Flood Elevation plus two feet, and enact a cumulative substantial improvement rule.

Issue/ Background: Currently, the City's floodplain management ordinance requires a freeboard of one foot above BFE. By adding an additional foot, structures will be protected from floods that exceed the 100-year flood, and insurance premiums will be further reduced. Property owners aware of the current substantial improvement requirements may circumvent the rule by making piecemeal improvements to the structure to avoid triggering the elevation requirements. The City is committed to ensuring ongoing compliance with NFIP requirements.

Other Alternatives Considered: No Action would result in continued enforcement of the one-foot freeboard, which does not provide property owners with maximum flood insurance premium discount.

Responsible Office: Codes Compliance and Planning, Department of Engineering and City Attorney

Priority (H, M, L): Medium

Cost Estimate: Staff Time.

Cost Benefit: By expending building costs for an additional course of block on new and substantially improved construction (approximately $1,500), homeowners will realize significant reduction in flood insurance premiums, and a reduction in average annual damages. The cumulative substantial improvement rule would help ensure that the value of flood-prone structures is not continually increased without being protected from flooding. Freeboard above the BFE reduces the chance of flooding based on mapping inaccuracies, floods that exceed the base flood, and damage from floating debris. CRS points are available for these activities.

Potential Funding: Existing budgets.

Schedule: Within one year of plan adoption.

Recommended Action Item #7: Develop Natural Hazards Curriculum for Public Schools

Issue/ Background: Schools have plans in place to direct student actions when natural hazards occur. Lessons targeted to grade level and seasons should be developed to accompany the emergency plans and inform students about the characteristics of natural hazards that may affect the region.

Other Alternatives Considered: No Action would result in a student body with knowledge of response actions, but little knowledge of the hazards directly. Another alternative considered included sending hazard information packets to parents, but again, the student body would not gain the necessary background on hazards desired.

Responsible Office: Newport News City Schools, Asst. Superintendent for Business, Emergency Management

Priority (H, M, L): Medium

Cost Estimate: $25,000

Cost Benefit: Parents will learn hazards information from their children, and children will be better informed, and therefore, better prepared for disasters. Many materials and curriculums are currently available.

Potential Funding: Community and civic groups, the Virginia Department of Education, the Virginia Department of Emergency Management, FEMA, and NOAA are potential sources of funding and materials.

Schedule: Within two years of plan adoption.

Recommended Action Item #8: Provide contingency planning assistance to small businesses.

Issue/ Background: In the lead-up and aftermath of Hurricane Isabel in 2003, necessary supplies were limited and small businesses that were not prepared had substantial business interruptions or, in some cases, failures. Damage from the storm's effects exacerbated the lack of planning and compounded the economic effects. FEMA acknowledges that small- to medium-sized businesses provide nearly 80 percent of the jobs in an average community, but are at great risk for failure after a disaster; 30 to 40 percent never reopen.

Other Alternatives Considered: Taking no action would not alleviate the financial effects on small business from another disaster. Outreach to large businesses was also considered; however, large franchised retailers and other ventures with corporate backing are more resilient than small businesses.

Responsible Office: Purchasing and Development

Priority (H, M, L): Medium

Cost Estimate: $50,000, to include city staff time and outreach materials.

Cost Benefit: Advance planning and mitigation can significantly increase the likelihood that small businesses can survive a disaster, keeping a community economically viable and helping to fuel the recovery.

Potential Funding: SBA, Economic Development Administration, and FEMA for materials, City's annual operating budget for staff time, and development of an assistance program with outreach. The Association of Contingency Planners, Old Dominion Chapter, should be contacted to determine their level of interest and possible involvement. Their help in training business leaders could reduce costs significantly.

Schedule: Within one year of plan adoption.

Recommended Action Item #9: Upgrade drainage system maintenance and increase maintenance frequency of stormwater drainage system.

Issue/ Background: Cleaning of the City's stormwater system was started in 1985 and expanded in the late 1990s, but inadequate funding has prevented annual cleaning of the entire system, which has resulted in flooding problems. Presently, City crews visit hot spots during intense rain storms resulting in extra man power and additional hours.

Other Alternatives Considered: Enacting an ordinance to require homeowners to clean adjacent ditches was considered and rejected. No action alternative also considered, but status quo is unsatisfactory. Recent significant staff and equipment upgrades will assist in increased maintenance, but additional targeted funding may continue to be necessary.

Responsible Office: Department of Public Works, City Manager's Office

Priority (H, M, L): Medium

Cost Estimate: $250,000 annually.

Cost Benefit: Overall maintenance of the stormwater system will remove blockages and decrease the potential for nuisance, urban flooding which primarily affects public infrastructure.

Potential Funding: Increase the Stormwater Fee by an appropriate percentage per month.

Schedule: Within three years of plan adoption.

Recommended Action Item #10: Implement flood hazard awareness program to: 1) inform existing property owners of their flood zone designation and flood insurance availability; 2) inform property owners and surveyors of FEMA's map amendment process; and 3) incorporate flood hazard awareness into Site Plan and Building Permit processes.

Issues/Background: Many property owners are not aware that, in conjunction with a local surveyor, they can more accurately ascertain the boundaries of the Special Flood Hazard Area depicted on the Flood Insurance Rate Maps (FIRM). The FEMA map amendment process can then be used to officially modify the FIRM if existing topography does not match FIRM boundaries. Accurately completed Elevation Certificates also benefit property owners by more precisely describing the pertinent site elevation data. Such a flood hazard awareness program is a creditable activity under CRS. Engineering and Codes Compliance have begun discussions about integrating the building permit application and approval processes with the City GIS, allowing for linkages to floodplain maps, full Elevation Certificates, and other awareness materials.

Responsible Office: Virginia Department of Conservation and Recreation, Virginia Association of Surveyors, Codes Compliance, Engineering, Public Works and Emergency Management.

Priority (H, M, L): Medium

Cost Benefit: Property owners would obtain more accurate flood zone determinations in the long run, which could reduce insurance premiums or increase flood insurance coverage, depending on the risk. Knowledge of flood hazards early in the building process reduces the likelihood of compliance issues.

Potential Funding: Existing budgets

Schedule: Implementation within two years of plan adoption

Recommended Action #11: Enroll Newport News in the Community Rating System (CRS). Prepare outreach materials to include: flood insurance availability; retrofitting existing structures; and hazard packets for new homeowners. Also prepare Repetitive Loss Plan as mandated.

Issue/Background: Newport News has numerous structures in the 100-year floodplain (5,250), a small number of NFIP policies (1,655; 32%) and a moderate number of repetitive losses (20). CRS provides a structured incentive program for multiple city agencies to address flood hazards by rewarding policyholders with premium discounts, enhancing public safety, reducing damage to property and public infrastructure, avoiding economic disruption and losses, reducing human suffering and protecting the environment.

Other Alternatives Considered: No action with regard to the CRS and NFIP Public Outreach is expected to result in increasing losses, and rising NFIP total premiums paid. Public outreach without CRS participation may not be as effective at reducing flood risk because policyholders and city policymakers may not experience such a notable premium savings.

Responsible Office: Department of Engineering, and Office of Emergency Management

Priority (H, M, L): Medium

Cost Estimate: Application submittal is free if completed by City Staff. Additional hours required for annual reviews and re-application every 5 years.

Cost Benefit: All of Newport News' 1,655 policyholders would benefit from the CRS premium savings, resulting in approximately $31,680 savings (5 percent savings for each individual policy) for a Class 9 rating. A Class 8 rating results in almost $64,000 savings.

Potential Funding: Existing Budgets

Schedule: Submit CRS application within one to two years of plan adoption

Recommended Action Item #12: Conduct engineering feasibility study of flood-proofing alternatives for four flood-prone pumping stations, and pursue available funding for cost-effective solutions. Elevate these pumping stations out of the floodplain to reduce future loss and damages and to virtually eliminate risk associated with wastewater for over four-thousand residents.

Issue/Background: In both Hurricane Floyd (1999) and Hurricane Isabel (2003), four pump stations within the 100-year floodplain were damaged by storm surge. Flooded stations are unable to pump water out of the neighborhoods and put nearly fifteen-hundred homes at risk for safety and sanitation reasons. The flooding is also taxing on work crews due to overtime hours spent keeping the system working and maintained. Emergency crews are put in danger when rescuing citizens affected by the flooding and unhealthy/unsafe sanitary conditions.

Other Alternatives Considered: If no action is taken the pump stations will continue to flood during hurricanes, strong rainstorms and nor'easters. Thousands of dollars in supplies and over-time labor will continue to accrue. Each time a pump station floods, roads are blocked and homes are flooded, leaving citizens in the service area vulnerable to unhealthy and unsafe sewage conditions. No action would continue to render the pump stations useless during flood conditions. Relocating the pump stations out of the floodplain is not a cost-effective option as significant portions of the service areas are also flood-prone.

Responsible Office: Public Works Wastewater Division and Engineering Stormwater Division

Priority (H, M, L): High

Cost Estimate: $2.4 million

Cost Benefit: Project will reduce the cost of overtime services, minimize the public health danger associated with the spillage of raw sewage, and reduce the need for voluntary citizen clean up after pump stations flood. Emergency service costs and hazards to employees will also be reduced during flood events.

Potential Funding: PDM, HMGP, City Budget

Schedule: Once plans are finalized, the elevations should take two years to complete. Each of the four pump stations are scheduled to be elevated within five years of plan adoption.

6.3.3 Williamsburg Mitigation Recommendations

Recommended Action Item #1: Implement Alert Warning System

Issue/ Background: The current alert system involving NOAA weather radio alerts is unreliable because radios can be unplugged or out of batteries, or antennas may not work. An LED read out in all government and critical facilities, including schools, will improve communications and allow instant relay of important information.

Other Alternatives Considered: The No Action alternative continues to rely on NOAA radio, which is unreliable in emergencies. Dispatching emergency personnel to critical facilities is time-consuming and involved risk to personnel. Telephoning critical facilities is also time-consuming and allows opportunities for human error or miscommunication.

Responsible Office: Fire Chief

Priority (H, M, L): High

Cost Estimate: $600/facility

Cost Benefit: The system improves communication in emergencies, thereby facilitating safe evacuation and potentially saving lives.

Potential Funding: Existing City budgets

Schedule: Within three years of plan adoption

Recommended Action Item #2: Achieve Storm Ready Certification from the National Weather Service

Issue/ Background: StormReady is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle severe weather. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations.

Other Alternatives Considered: Taking the actions necessary to achieve Storm Ready Certification without applying for the certification was considered, but rejected. The certification itself is an incentive to pursue changes.

Responsible Office: Emergency Management

Priority (H, M, L): High

Cost Estimate: Staff time

Cost Benefit: These efforts and planning activities would lead to long-standing changes in vulnerability and, depending upon status of current efforts and programs, can be initiated at very little cost.

Potential Funding: Existing budgets

Schedule: Within two years of plan adoption.

Recommended Action Item #3: Strengthen GIS digital mapping program for cadastral and hazard planning purposes. Continue process of adding data layers, improving hardware capabilities, and expanding software availability across City departments.

Issue/ Background: The City's land use/ownership, zoning, and hazard mapping were only available through hard copy files and traditional cartographic methods until about 2004. Through several grants and City funding, a GIS division within the Finance Department has been created. Strengthening the fledgling program is now the priority.

Other Alternatives Considered: The No Action alternative is unacceptable as traditional hard copy maps do not last as long, cannot be easily edited or updated, and are more vulnerable to loss or destruction.

Responsible Office: Finance Department

Priority (H, M, L): High

Cost Estimate: Staff time, (previously approved) $8,000 grant, plus hardware costs of approximately $6,000 annually.

Cost Benefit: The durability and usefulness of digital mapping information for hazard and land use planning is well documented. GIS can be used to reduce losses from natural hazards through: improved evacuation planning; floodplain information accessibility; disaster recovery; and pre-identification of mitigation opportunities. Map data can be shared within the community and with contractors, property owners and others interested in using Williamsburg's cadastral database.

Potential Funding: Homeland Security grant provided software, and Annual City Budget funds staff time, NOAA Coastal Service Center GIS Integration and Development program.

Schedule: Ongoing

Recommended Action Item #4: Evacuation Shelter Generator Upgrades

Issue/ Background: Previously, a shared evacuation shelter with James City County provided less-than-optimal conditions. A new shelter, dedicated to Williamsburg residents, and certified by the American Red Cross, will come online in the near future. Backup generator power for the new facility remains a necessity.

Other Alternatives Considered: Continued use of the shared facility did not adequately serve Williamsburg's residents. Without generator power at the new facility, the housing and feeding of evacuees is more difficult, and possibly dangerous.

Responsible Office: Emergency Management, American Red Cross

Priority (H, M, L): Medium

Cost Estimate: $25,000 per shelter

Cost Benefit: The new, improved evacuation shelter is more centrally located for Williamsburg residents, facilitating a faster and safer evacuation process.

Potential Funding: Existing budgets

Schedule: Ongoing, with generator hookups installed by 2007.

Recommended Action Item #5: Train CERT team members for personal pre-disaster planning and neighborhood response teams, and establish emergency communication system for same.

Issue/ Background: Pre-disaster preparation, whether installation of plywood window covers or ditch clean-out, helps reduce damage from natural disasters. Neighborhood response and communication in the aftermath of a disaster helps prevent compound damages, and protects life and safety. For neighborhoods without power or emergency access, the CERT team members can help relay important messages from City officials.

Other Alternatives Considered: CERT teams with willing volunteers are already established in Williamsburg. The same training provided to City officials is not as effective because they do not have the same neighborhood—level interaction with property owners.

Responsible Office: Emergency Management

Priority (H, M, L): Medium

Cost Estimate: $12,000 for materials and training over a two year period. $6,000 for equipment.

Cost Benefit: These actions will reduce pre- and post-disaster confusion, improve property owner protection levels, and reduce damages to structures and infrastructure. By helping property owners identify mitigation measures for their owner property, CERT members will foster better-prepared neighborhoods.

Potential Funding: HMGP, City operating budget, FEMA

Schedule: Within three years of plan adoption

Recommended Action Item #6: Continue programs and capital improvements to upgrade drainage system citywide, including Colonial Williamsburg.

Issue/ Background: Williamsburg's urban drainage system dates back almost 40 years, and the system requires routine maintenance and infrastructure improvements to accommodate existing and new development. Ongoing enhancements help alleviate urban flooding of intersections and low-lying areas. Colonial Williamsburg Foundation performs an annual storm drain maintenance program in the Historic Area, under the direction of the City of Williamsburg.

Other Alternatives Considered: Complete drainage system overhaul for Williamsburg and the Historic District would disrupt tourism and be extremely costly. No action with regard to drainage system improvements, while new development continues, could exacerbate current nuisance flooding.

Responsible Office: City of Williamsburg Public Works and Utilities, and Colonial Williamsburg Foundation

Priority (H, M, L): Medium

Cost Estimate: $25,000/year for Colonial Williamsburg Foundation. Variable annual costs for Williamsburg as dictated by annual Capital Improvement Program budget.

Cost Benefit: Reduction of nuisance flooding increases the life of infrastructure, while eliminating flooding of intersections eases the burden on public safety officials and facilitates citywide access to businesses and attractions despite inclement weather. Protection of valuable national historic resources in the Historic District is an important goal of the Colonial Williamsburg Foundation.

Potential Funding: City's Capital Improvement Program (funded by one percent sales tax receipts and other funds). Costs for projects in the Historic Area are shared with the Colonial Williamsburg Foundation.

Schedule: Within two years of plan adoption.

Recommended Action Item #7: Colonial Williamsburg Annual Tree Maintenance Program

Issue/ Background: Colonial Williamsburg has instituted an annual tree trimming program to minimize damage from wind and ice. Trees are systematically trimmed to open up and allow the trees to withstand sustained winds of 80-90 mph. Trees are a major cause of sustained power outages due to both strong winds and ice accumulation during winter storms. Large, older trees in the Historic District may also threaten vulnerable historic structures if felled by wind or ice.

Other Alternatives Considered: No action with regard to tree maintenance fails to protect historic resources from wind and ice, and could result in prolonged power outages.

Responsible Office: Colonial Williamsburg Foundation

Priority (H, M, L): Medium

Cost Estimate: $75,000/year

Cost Benefit: Expenditures to maintain storm-resistant trees results in lower average annual damages to historic structures and infrastructure from wind and ice storms.

Potential Funding: Existing budgets.

Schedule: Ongoing.

Recommended Action Item #8: Disaster-Resistant University (DRU) Planning for the College of William & Mary

Issue/ Background: Disasters can and do affect university and college campuses, and impose monetary losses and disruption of the institution's teaching, research, and public service. These losses can be substantially reduced or eliminated through pre-disaster planning and mitigation actions.

By assisting the College of William and Mary with disaster-resistant university planning, the City of Williamsburg further mitigates the need for costly emergency response and cleanup from hazard events. The university should prepare a Disaster-Resistant University Mitigation Plan that is coordinated across William and Mary's various departments, integrated into the University's existing plans, and prepared in conjunction with the City's planning goals.

University officials took part in the planning process for this Hazard Mitigation plan, and over the course of the planning process, became familiar with the general plan structure.

Other Alternatives Considered: No action

Responsible Office: Williamsburg Emergency Management; William & Mary Facilities Management officials

Priority (H, M, L): Medium

Cost Estimate: $35,000

Cost Benefit: A plan that effectively coordinates the various functions of the university and the city before, during and after a disaster would result in cost savings for both the university and the municipality.

Potential Funding: FEMA DRU funding; VDEM; City of Williamsburg

Schedule: Within 4 years of plan adoption.

Recommended Action Item #9: Request that the State NFIP Coordinator's Office at the Virginia Department of Conservation and Recreation review the City's floodplain management ordinance to ensure that Substantial Improvement/Substantial Damage language is up to date.

Issue/ Background: RPA and RMA zones adopted as part of the Chesapeake Bay Preservation Ordinance are 100 feet and 500 feet, respectively. The ordinance serves as the City's floodplain management ordinance, but may not adequately address new structure requirements and remodeling or alterations to nonconforming principal structures, utilities, railroads and other infrastructure. VaDCR floodplain managers can review the ordinance and recommend any necessary changes to remain compliant with NFIP minimum standards. The City is committed to ensuring ongoing compliance with NFIP requirements.

Other Alternatives Considered: No action may jeopardize the community's continued participation in the NFIP.

Responsible Office: Williamsburg Emergency Management; Williamsburg Department of Planning; VaDCR

Priority (H, M, L): Medium

Cost Estimate: Staff Time

Cost Benefit: Continued availability of flood insurance in the community as a result of continued compliance with NFIP ordinance requirements.

Potential Funding: Not applicable.

Schedule: Within 2 years of plan adoption.

6.3.4 James City County Mitigation Recommendations

Recommended Action Item #1: Continue flood-prone structure elevation project, focusing on Chickahominy Haven, and the county's seven repetitive losses.

Issue/ Background: Chickahominy Haven is a James City County neighborhood with 192 homes along the Chickahominy River. The neighborhood association is very active. As a result of Hurricane Isabel, flooding damaged numerous houses. Elevation of the most severely damaged, and repetitively flooded structures is a priority for the County. Five of the county's repetitive loss structures are in Chickahominy Haven.

Other Alternatives Considered: The floodplain of the Chickahominy River is wide, and relocating properties on the same parcel and out of the floodplain is rarely possible. Acquisition of home sites in this area was not desirable from the County's perspective due to maintenance requirements.

Responsible Office: Emergency Management and Planning

Priority (H, M, L): High

Cost Estimate: $154,000 for elevation of three homes; additional funding for at least two more repetitively flooded homes will be pursued.

Cost Benefit: Elevation of these structures is expected to protect contents and residents from the 100-year flood. Protecting repetitively flooded structures will result in savings being achieved by property owners, the community, and NFIP.

Potential Funding: FEMA HMGP Grant 75%, VDEM 20%, and 5% County in-kind services.

Schedule: Grant has been approved and the elevation projects are being bid to contractors.

Recommended Action Item #2: Conduct certified lowest floor elevation surveys of existing homes, manufactured homes and commercial structures in identified floodplains. Include County-wide housing needs assessment.

Issue/ Background: The County Comprehensive Plan, Housing Element Action 14, includes a recommendation for a County-wide assessment of housing conditions geared toward rehabilitating substandard housing and eliminating vacant or dilapidated structures. Performing simultaneous surveys to determine flood risk for existing structures will help prioritize structures based not only on structural condition, but also vulnerability to flood hazards. Further, identifying manufactured homes in the floodplain will aid County emergency managers in setting evacuation priorities for flood events. A database of lowest floor elevations may be creditable through CRS, and is an invaluable planning tool for prioritizing elevation and retrofit projects in the future.

Other Alternatives Considered: Surveying lowest floors as a separate project necessitates two visits to each structure. Doing the housing needs assessment without collecting elevation data provides an incomplete analysis with regard to potential damage, and will not be creditable under CRS.

Responsible Office: Development Management and Community Services

Priority (H, M, L): High

Cost Estimate: $150,000 (individual FEMA Elevation Certificates may cost as much as $250 each, depending on location and terrain. Cost savings may be realized if neighborhoods are surveyed at one time.)

Cost Benefit: A database of structural elevations in and near floodplains aids county planners in prioritizing structures that are most vulnerable to flood risk. If credit is granted through CRS, flood insurance policyholders may save additional money on premiums.

Potential Funding: HMGP, PDM, Virginia Department of Housing and Community Development Rehabilitation Grant programs, CDBG

Schedule: Implementation within two years of plan adoption.

Recommended Action Item #3: Revise site plan application, building permit application and accompanying checklists to include/require detailed information on the flood hazard, to include flood zone, map number and date, and Base Flood Elevation. Job Site cards should also have BFE indicated. Consider Emergency Management participation in development reviews to solicit input on natural hazards, ingress/egress, and other evacuation-related concerns.

Issue/ Background: All of the applications and checklists do not currently require this information. The County is committed to ensuring ongoing compliance with NFIP requirements.

Other Alternatives Considered: No action with regard to this activity could jeopardize participation in the NFIP and CRS. Revision of simply the Building Permit would satisfy NFIP requirements, but all such documents should be examined simultaneously to provide clear direction to builders and developers.

Responsible Office: Code Compliance

Priority (H, M, L): High

Cost Estimate: $500 for staff time and copying costs

Cost Benefit: Clear direction regarding implementation of the floodplain management ordinance and information about flood risk reduces compliance issues and results in structures that are at less risk of flood damage.

Potential Funding: Existing budgets.

Schedule: Immediately

Recommended Action Item #4: Implement the Comprehensive Plan element to "protect County shorelines from erosion through a coordinated, unified area approach that utilizes properly designed methods of vegetative or structural stabilization, bank regrading, beach nourishment and/or relocation of activities to less sensitive areas."

Issue/ Background: The County's Erosion and Sediment Control program adequately regulates land disturbance activities in accordance with State regulations. Missing is a program element to address existing shoreline problem areas that can exacerbate storm damage, and detrimentally affect water quality. A citizen advisory/assistance program for shoreline erosion, in conjunction with the knowledgeable professionals of Virginia Department of Conservation and Recreation's Shoreline Erosion Advisory Service would address this deficiency.

Other Alternatives Considered: Regulating new development projects, while overlooking shoreline problem areas on private property, does not adequately address erosion problems. Having a free assistance program in place to intercept and help property owners before they have to take drastic action or before they take action without a permit benefits both the County and property owners.

Responsible Office: County Development Management, Virginia DCR

Priority (H, M, L): Medium

Cost Estimate: $10,000 for public outreach and staff time to support project identification and customer assistance.

Cost Benefit: Reduction of shoreline erosion contributes to better water quality, more recreational use of the shoreline, and reduced storm damage.

Potential Funding: County Operating Fund, Virginia DCR, NOAA

Schedule: Implementation with three years of plan adoption.

Recommended Action Item #5: Adopt an ordinance requirement for floodplain structure elevation to Base Flood Elevation plus two feet.

Issue/ Background: Currently, the County's floodplain management ordinance requires a freeboard of one foot above BFE. By adding an additional foot, structures will be protected from floods that exceed the 100-year flood, and insurance premiums will be reduced.

Other Alternatives Considered: No Action would result in continued enforcement of the one-foot freeboard, which does not provide property owners with maximum flood insurance premium discount.

Responsible Office: Code Compliance

Priority (H, M, L): Medium

Cost Estimate: Minimal cost of implementation.

Cost Benefit: By expending building costs for an additional course of block (approximately $1,500) for new and substantially improved structures, homeowners will realize significant reduction in flood insurance premiums, and a reduction in average annual damages. Cost to the County is minimal.

Potential Funding: Existing budgets.

Schedule: Within two years of plan adoption.

Recommended Action Item #6: Provide disaster mitigation planning assistance to small businesses.

Issue/ Background: In the lead-up and aftermath of Hurricane Isabel in 2003, necessary supplies were limited and small businesses that were not prepared had substantial business interruptions or, in some cases, failures. Damage from the storm's effects exacerbated the lack of planning and compounded the economic impacts. FEMA acknowledges that small- to medium-sized businesses provide nearly 80 percent of the jobs in an average community, but are at great risk for failure after a disaster; 30 to 40 percent never reopen after a disaster.

Other Alternatives Considered: Taking No Action would not alleviate the financial effects on small businesses from another disaster. Outreach to large businesses was also considered; however, large franchised retailers and other ventures with corporate backing are more resilient than small businesses.

Responsible Office: Community Services, Emergency Management

Priority (H, M, L): Medium

Cost Estimate: $50,000, to include staff time and outreach materials.

Cost Benefit: Experience has shown that advance planning and mitigation can significantly increase the likelihood that small businesses can survive a disaster, keeping a community economically viable and helping to fuel the recovery.

Potential Funding: SBA, Economic Development Administration, FEMA for materials, and County's annual operating budget for staff time and development of an assistance program with outreach component. The Association of Contingency Planners, Old Dominion Chapter, should be contacted to determine their level of interest and possible involvement. Their help in training business leaders could reduce costs significantly.

Schedule: Within one year of plan adoption. Community has already begun working with nursing homes, assisted living facilities, private schools and daycare centers with regard to mitigation planning and disaster recovery.

Recommended Action Item #7: Expand Drought-Resistant Landscaping Program elements, to include private property owners, commercial projects, and County lands.

Issue/ Background: Drought-related hazards in James City County are currently addressed through the James City Service Authority's (JCSA) WaterSmart program for homeowners, water use restrictions for irrigation, and rain sensor requirements for new irrigation systems. JCSA is the agency charged with operating the County's drinking water system. Activities include a comprehensive water management and education program to help residents maintain high quality landscaping while taking a smart approach to water use. However, the landscaping ordinance that applies to new County site plans does not require the same drought-resistant strategies, or provide incentives for using drought-tolerant plant species. The County must also address drought hazard management through wise use strategies on its own lands. The drought-resistant garden plot at the EOC is an excellent example of how the County can share hazard priorities with the public.

Other Alternatives Considered: Water restrictions during droughts are an imposition and inconvenience if property owners are not aware of the hazard. If drought-resistant strategies are espoused year-round for all property owners, and practiced by the County, the public is more receptive to water restrictions and other more extreme measures when necessary.

Responsible Office: James City Service Authority, Development Management, and Facilities Management (Parks & Grounds Maintenance)

Priority (H, M, L): Medium

Cost Estimate: Minimal staff time to revise Landscape Ordinance and seek approval.

Cost Benefit: By increasing drought-tolerant plant species, and drought-resistant landscaping techniques throughout the County, the use of water for irrigation will be reduced. Costs are minimal, but benefits will be apparent during droughts.

Potential Funding: Existing budgets.

Schedule: Implementation within one year of plan adoption.

Recommended Action Item #8: Convene a task force to study the wildland fire hazard and the urban interface. The task force could make recommendations regarding additional building code requirements in a mapped "interface zone", outreach and complementary inspections for homeowners, or additional building considerations to be distributed to builders.

Issue/ Background: The "high" wildfire hazard area for James City County covers 47.6 square miles (30,464 acres) in area and downed trees from recent tropical storms have dramatically increased the combustible fuel sources. As development pressure increases in parts of the County without public water supply, so do the number of structures in the urban interface at risk to fire. Two primary factors influence a home's ability to survive wildfire. These are the home's roofing material and the quality of the "defensible space" surrounding it. Teaching homeowners about "defensible space" is a valuable tool for the County.

Other Alternatives Considered: A simple outreach program for homeowners was also considered. Without mapping and careful consideration of outreach content, the program could alarm rather than inform residents.

Responsible Office: Emergency Management, Fire Department, GIS personnel

Priority (H, M, L): Low

Cost Estimate: $5,000 for outreach materials, plus minimal staff time for inspections and building code considerations. See **www.firewise.org** for additional materials.

Cost Benefit: Minimal costs would result in a marked increase in homeowner awareness of the fire hazard and measures that could be taken on individual properties to mitigate the hazard. Average annual damages from fire would be minimized through individualized inspections and targeted recommendations.

Potential Funding: Existing budgets.

Schedule: Task Force creation within two years of plan adoption; implementation of task force recommendations within additional two years.

6.3.5 York County Mitigation Recommendations

Recommended Action Item #1: Revise floodplain management ordinance to: 1) adopt cumulative substantial improvement rule; and, 2) adopt two feet of freeboard above the Base Flood Elevation. Additions/renovations within a ten-year time frame that cumulatively equal 50 percent of a structure's appraised value trigger compliance with the ordinance's elevation requirements.

Issue/Background: County building officials currently make strong recommendations regarding freeboard in an effort to reduce flood insurance premiums for new structures. Codifying the recommendation is the next logical step, and would result in CRS creditable points. Property owners aware of the current substantial improvement requirements may circumvent the rule by making piecemeal improvements to the structure to avoid triggering the elevation requirements.

Other Alternatives Considered: Other alternatives to the 10-year cumulative substantial improvement rule were examined, including a shorter, 5-year accumulation period. Ten years seems appropriate for the level of renovations taking place, has worked well for other communities, and shorter time periods can cause conflicts with property re-sales.

Responsible Office: Department of Environmental and Development Services, Building Regulations and York County Board of Supervisors

Priority (H, M, L): High

Cost Estimate: Staff Time

Cost Benefit: Evidence of the effectiveness of elevating structures above the Base Flood Elevation is ample. The cumulative substantial improvement rule would help ensure that the value of flood-prone structures is not continually increased without being protected from flooding. The rule would also help address repetitive losses that may otherwise never meet the 50 percent criteria. Freeboard above the BFE reduces the chance of flooding based on mapping inaccuracies, floods that exceed the base flood, and damage from floating debris. CRS points are available for this activity, and York County is a CRS participant.

Potential Funding: None.

Schedule: Implementation contingent on funding and staffing availability.

Recommended Action Item #2: Implement flood hazard awareness program to: 1) inform existing property owners of their flood zone designation and flood insurance availability; 2) inform property owners and surveyors of FEMA's map amendment process; and, 3) incorporate flood hazard awareness into Site Plan and Building Permit processes.

Issue/Background: Many property owners are not aware that, in conjunction with a local surveyor, they can more accurately ascertain the boundaries of the Special Flood Hazard Area depicted on the Flood Insurance Rate Maps (FIRM). The FEMA map amendment process can then be used to officially modify the FIRM if existing topography does not match FIRM boundaries. Accurately completed Elevation Certificates also benefit property owners by more precisely describing the pertinent site elevation data. Such a flood hazard awareness program is a creditable activity under CRS. Only 50 percent of the structures within York County floodplains currently carry flood insurance. The County is committed to ensuring ongoing compliance with NFIP requirements.

Responsible Office: Department of Financial and Management Services, Computer Support Services, Department of Environmental and Development Services, Building Regulations, Department of Fire and Life Safety, Office of Emergency Management, Virginia Department of Conservation and Recreation, and the Virginia Association of Surveyors, Inc.

Priority (H, M, L): High

Cost Estimate: Staff Time

Cost Benefit: Property owners would obtain more accurate flood zone determinations in the long run, which could reduce insurance premiums or increase flood insurance coverage, depending on the risk. Knowledge of flood hazards early in the building process reduces the likelihood of compliance issues.

Potential Funding: Existing budgets

Schedule: On-going

Recommended Action Item #3: Storm Water Capital Improvement Projects

Issue/Background: According to the York County Strategic Capital Improvements Plan for Waste and Storm Water, several county drainage systems are not properly sized for their respective drainage area, and resultant flooding is problematic.

Responsible Office: Department of Environmental and Development Services, Utilities

Priority (H, M, L): High

Cost Estimates: $ 5,000,000

Cost Benefit: Reduces homeowner losses due to urban flooding and enhances public safety services by reducing flooding of roadways and maintaining access to most areas of the County

Potential Funding: General Fund - Capital Improvement Projects; also, VDOT Revenue Sharing Program funds for projects with VDOT rights-of-way.

Schedule: Implementation over the next five years.

Recommended Action Item #4: Evaluate critical facilities for safety and sustainability during emergencies and take appropriate corrective actions to include providing backup power to critical facilities to protect the public and maintain continuity of government.

Issue/Background: York County experiences all types of severe weather, which stresses the structural integrity of critical facilities and infrastructure, i.e. electrical utilities. The County plans to complete a survey of critical facilities to determine the most effective and efficient use of space and take appropriate corrective actions to protect the occupants of these facilities and maintain continuity of government services. The electric company's power restoration priorities serve areas within higher population densities and consequently many areas of York County remain without power for longer periods than those areas with higher population density. It is not unusual for areas of the County to be without power for several weeks during severe winter weather. The County desires to establish a warming or cooling shelter to be used in times of severe weather emergencies, this would require the shelter to have backup power to run the HVAC system along with lighting in shelter areas, hot water, and the capability to store and prepare food, and certain outlets powered to support medically/electric dependent residents. Other shelters require sufficient backup power to support lighting in shelter areas, power up certain electric outlets, hot water, and capacity to store and prepare food. The County is considering several existing buildings as an alternate EOC; however, none of the facilities under consideration have generator power. The County Fire Stations have backup power; however, during Isabel it was realized that the backup power was not sufficient to support first responders working from those locations. Other facilities critical to maintaining continuity of government, which have been identified by the County, have no backup power as well.

Other Alternatives Considered: To stay with current practices and provide no backup power at shelters, alternate EOC or other facilities critical to continuity of government.

Responsible Office: York County Department of Fire and Life Safety, Office of Emergency Management, York County School Division, York County Department of Financial and Management Services, and York County Department of General Services.

Priority (H,M,L) High

Cost Estimate: $1,000,000 – $ 2.500,000

Cost Benefit: Ensuring the critical facilities are being used to their highest effective and efficient use with appropriate safeguards and backup power is an important emergency mitigation consideration. Having a shelter where the space is used most efficiently and effectively, which receives those who are medically dependent on electricity or who are frail with low tolerance to severe weather can be life sustaining. Sheltering becomes a more desirable alternative to staying at home, which reduces the risk of individual house fires, injuries, and the consumption of spoiled food. Adequate backup power at fire stations ensures that there will be HVAC at each station during an emergency, that there is adequate lighting, access to computers, communications, hot water, and a means to prepare and store food. In order to maintain continuity of government in an emergency, backup power for alternate EOC is essential to maintaining response and recovery activities if damage occurs to the existing facility. Also, other critical facilities have been identified by the County to maintain the continuity of government in an emergency and they will be included in this project.

Potential Funding: General Fund – Capital Improvement Projects, cost share with the school division; and grants.

Schedule: Implementation contingent on funding availability.

Recommended Action Item #5: Maintain low-density zoning in flood-prone areas.

Issue/Background: Many parcels in the floodplain are currently vacant, but capable of being subdivided and developed. Maintaining these areas as low-density residential (1 unit per acre is the current land use standard for low-density residential development) will limit the potential number of residences subject to future flood damages. Financial strategies and incentives should be explored as part of this solution. Examples include purchase or transfer of development rights and lease-back arrangements.

Other Alternatives Considered: An alternative to this measure would be to rezone flood-prone areas to require more than one acre per dwelling unit (such as the RC

Resource Conservation district, which requires 5 acres per unit). However, reduction of property values and concerns regarding legislative land takings make this alternative infeasible.

Responsible Office: County Administration, Planning Division, and York County Board of Supervisors

Priority (H, M,L): High

Cost Estimate: Staff Time

Cost Benefit: The investment of time and minimal funds necessary to protect these areas from development will significantly reduce flood damage to future development, and reduce potential loss of life. Numerous CRS points are available for this activity.

Potential Funding: Existing budgets

Schedule: Ongoing

Recommended Action Item #6: Increase accessibility to digital elevation certificate data.

Issue/ Background: Currently, completed elevation certificates are collected and entered into the County's computer system using FEMA software program. The data is entered by the County Building Official and is time consuming. The software has limitations in data retrieval and sorting. The software needs to be adapted to be user friendly and provide more utility.

Other Alternatives Considered: Paper copies are bulky and do not last as long as digital data. No Action would result in continued problems accessing data for other floodplain management purposes.

Responsible Office: Department of Environmental and Development Services, Building Regulation, and Department of Financial and Management Services, Computer Support Services.

Priority (H, M, L): Medium

Cost Estimate: Minimal cost for staff time to reconfigure database access.

Cost Benefit: Sharing of this data will increase opportunities for mitigation projects, and provide emergency management and land-use planners with a useful floodplain management tool at minimal cost. CRS points available for this activity.

Potential Funding: Existing budgets

Schedule: Implementation contingent on staffing and available technology.

Recommended Action Item #7: Site plan submitted with the building permit application shall include detailed information on the flood hazard, to include flood zone, map number and date, and base flood elevation.

Issue/Background: All of the applications and checklists do not currently require this information.

Other Alternatives Considered: No action with regard to this activity could jeopardize participation in the NFIP and CRS. Revision of simply the Building Permit form would satisfy NFIP requirements, but all other such documents should be examined simultaneously to provide clear direction to builders and developers.

Responsible Office: Department of Environmental and Development Services, Building Regulations, and the Division of Development and Compliance

Priority (H, M, L): High

Cost Estimate: Staff time and copying costs

Cost Benefit: Clear direction regarding implementation of the floodplain management ordinance and information about flood risk reduces compliance issues and results in structures that are at less risk of flood damage.

Potential Funding: Existing budgets.

Schedule: On-going

Recommended Action Item #8: Maintain an awareness of and support for the Newport News Department of Public Utilities (Waterworks) forest management program to mitigate wildfire hazards and promote the health of forests within the reservoir watersheds. Eight percent of the land area in York County is owned by Newport News Waterworks and is considered part of the reservoir watershed.

Issue/Background: The Newport News Department of Public Utilities (Waterworks) has maintained a comprehensive forest management program for over 20 years. The program includes fire trails, clear-cutting, thinning, disease control and other elements to maintain healthy forests. The program works in conjunction with a Newport News Watershed Protection ordinance. Additionally, coordination of property owners must take place. Fifty percent of York County is subject to fire, but 17 percent of that land is owned and managed by the federal government.

Other Alternatives Considered: Due to the wildfire hazard risk in York County, this practice cannot be ignored.

Responsible Office: Newport News Waterworks, Chief of Forest Resources in coordination with York County Department of Environmental and Development Services, Division of Utilities and the Department of Fire and Life Safety, Division of Fire Prevention and Life Safety

Priority (H, M, L): Medium

Cost Estimate: Staff time

Cost Benefit: The forest program's main objective is water quality protection, and it helps maintain the quality of the system's existing raw water sources, but more importantly is serves as a means to reduce the risk of wildfire hazards in the watershed areas.

Potential Funding: Existing budget for personnel costs

Schedule: Ongoing.

Recommended Action Item #9: Support a comprehensive water conservation program to mitigate drought hazards.

Issue/Background: Newport News Department of Public Utilities (Newport News Waterworks) developed a water conservation program approximately 15 years ago and it was modified in 2005 (effective January, 2007). The plan is based on encouraging water conservation through surcharges and penalties for excess use, and restrictions during drought conditions. This plan has proven to be effective as Waterworks has one of the lowest per capita water uses in the state. The plan covers all jurisdictions in the Waterworks service area, including: Newport News, Hampton, and portions of York and James City County. The proposed action involves continued implementation of the program, with additional activities and programs added, as necessary.

Other Alternatives Considered: The Department is considering additional sources of potable water and raw water through creation of a new reservoir. No Action to renew the water conservation plan could create more damages resulting from drought hazards.

Responsible Office: Newport News Waterworks in coordination with York County Department of Environmental and Development Services, Division of Utilities

Priority (H, M, L): Medium

Cost Estimate: Staff Time

Cost Benefit: The water conservation plan and its associated activities help maintain water supply during drought conditions.

Potential Funding: Existing budget for personnel costs.

Schedule: Ongoing

Recommended Action Item # 10: Provide contingency planning assistance to small businesses.

Issue/Background: In the lead-up and aftermath of Hurricane Isabel in 2003, necessary supplies were limited and small businesses that were not prepared had substantial business interruptions due to power outages and/or structure damage. Damage from the storm's effects exacerbated the economic effects on several small businesses. These businesses couldn't provide the needed goods and services to customers, many of whom were County residents during the immediate recovery efforts.

Other Alternatives Considered: Taking " No Action" would not alleviate the damaging effects on small business during another disaster. Outreach to large businesses can be considered; however, large franchised retailers and other ventures with corporate backing are more resilient than small businesses.

Responsible Office: County Administration, Office of Economic Development and Department of Fire and Life Safety, Office of Emergency Management, York County Chamber of Commerce

Priority (H, M, L): Medium

Cost Estimate: Staff time, workshop costs, and outreach materials.

Cost Benefit: Advance planning and mitigation can significantly increase the likelihood that small businesses can survive a disaster, keeping a community economically viable and helping to fuel the recovery.

Potential Funding: Grants from agencies, such as SBA, existing County budget for personnel costs, and assistance from York County Chamber of Commerce and other organizations, such as the Association of Contingency Planners, Old Dominion Chapter.

Schedule: Implementation contingent on staffing and funding availability

Recommended Action Item #11: Achieve Storm Ready Certification from the National Weather Service.

Issue/Background: Storm Ready is a nationwide community program that uses a grassroots approach to help communities develop plans to handle severe weather. The program signifies to the public that a community has developed procedures for operational response to severe weather. Currently York County coordinates with York County School Division for tornado awareness and exercises with the school division every spring. The County has a number of procedures in place for response to severe weather. However, the County hasn't completed the application process for Storm Ready designation.

Other Alternatives Considered: Taking the actions necessary to achieve Storm Ready Certification without applying for the certification was considered, but rejected. The certification is a means to keep the public informed about the importance of being prepared and that the community places it as a high priority.

Responsible Office: Department of Fire and Life Safety, Office of Emergency Management

Priority (H, M, L): High

Cost Benefit: Applying for StormReady designation and maintaining the criteria to keep the designation places the importance and awareness as a high priority in the community and with the public.

Potential Funding: Existing budget for personnel costs.

Schedule: Implementation contingent upon staffing priorities.

Recommended Action Item #12: Implement the Comprehensive Plan element "protect County shorelines from erosion through a coordinated, unified area approach that utilizes properly designed methods of vegetative or structural stabilization, bank regrading, beach nourishment and/or relocation of activities to less sensitive areas."

Issue/ Background: The County's Erosion and Sediment Control program adequately regulates land disturbance activities in accordance with State regulations. Missing is a program element to address existing shoreline problem areas that can exacerbate storm damage, and detrimentally affect water quality. A citizen advisory/assistance program for shoreline erosion, in conjunction with the knowledgeable professionals of Virginia Department of Conservation and Recreation's Shoreline Erosion Advisory Service would address this deficiency.

Other Alternatives Considered: Regulating new development projects, while overlooking shoreline problems. Private property owners are often unaware of the most cost-effective and successful strategies to adequately address shoreline erosion problems. Having a program in place to intercept and help property owners before they have to take drastic action, or before they take action without a permit, benefits both the County and property owners.

Responsible Office: Virginia DCR

Priority (H, M, L): Medium

Cost Estimate: $10,000 for public outreach and staff time to support project identification and customer assistance.

Cost Benefit: Reduction of shoreline erosion contributes to better water quality, more recreational use of the shoreline, and reduced storm damage.

Potential Funding: County Operating Fund, Virginia DCR, NOAA, Colonial Soil & Water Conservation Service

Schedule: Implementation contingent on funding availability.

Recommended Action Item #13: Elevate flood-prone homes/reduce repetitive flood losses

Issue/Background: Reduce property damage from repetitive flooding by elevating homes in flood-prone areas of the county that meet criteria of the HMPG and other floodplain management elevation programs. There are 30 repetitive loss properties in York County. A repetitive loss plan is a requirement of CRS participation when there are more than 10 repetitive losses.

Other Alternatives Considered: Relocation of flood-prone structures was considered, but York County is relatively built-out and the floodplain area is extensive. Acquisition of properties and relocation of residents would be prohibitively expensive to undertake.

Responsible Office: Office of Emergency Management and Planning Office

Priority (H, M, L): High

Cost Estimate: $30,000 per home (estimate 50 homes); total of $1,500,000

Cost Benefit: Average annual damages are substantially reduced when structures are elevated to or above the Base Flood Elevation.

Potential Funding: Hazard Mitigation Grant Program, FMA, PDM

Schedule: Implementation contingent on funding availability.

7.0 Plan Implementation and Maintenance

Implementation implies two concepts: action and priority. While this plan puts forth many worthwhile recommendations, the decision regarding which action to undertake first will be the initial issue each community faces. Committee members should not only account for priority when considering which task should be addressed first, they should also consider the issue of funding. Therefore, low or no-cost recommendations have the greatest likelihood of succeeding. An example would be updating the floodplain management ordinance to mandate two feet of freeboard. These efforts would lead to long-standing changes in vulnerability and can be initiated at very little cost, while simultaneously reducing flood insurance premiums.

Another important implementation mechanism that is highly effective but low-cost is taking steps to incorporate the recommendations, and equally important, the underlying principles of this Hazard Mitigation Plan into other community plans such as the Comprehensive Plan, capital improvement budgeting, economic development goals and incentives, and other such plans. Mitigation is most successful when it is incorporated within the day-to-day functions and priorities of government and development. This integration is accomplished by a constant, pervasive and energetic effort to network and to identify and highlight the multi-objective, "win-win" benefits to each program, the community and the constituents. This effort is achieved through monitoring agendas, attending meetings, sending memos, and promoting a safe, sustainable community.

Monitoring funding opportunities should be done simultaneously with the integration effort. Funding can be leveraged to implement some of the more costly recommendations. A bank of ideas on how any required local match or participation requirements can be met should be created and maintained. Being aware of when funding becomes available will allow the Committee to capitalize upon important opportunities. Funding opportunities that can be monitored include special pre- and post-disaster funds, special district budgeted funds, state or federal ear-marked funds, and grant programs, including those that can serve or support multi-objective applications.

With the adoption of this plan, the PHMPC will be converted to a permanent advisory body referred to as the Mitigation Coordinating Committee. This Committee agrees and commits to:

- Act as a forum for hazard mitigation issues,
- Disseminate hazard mitigation ideas and activities to all participants,
- Pursue the implementation of the high priority, low/no-cost Recommended Actions,
- Keep the concept of Mitigation in the forefront of community decision-making by identifying the recommendations of this plan when other community goals, plans, and

activities overlap, influence, or directly affect increased community vulnerability to disasters,

- Maintain a vigilant monitoring of multi-objective cost-share opportunities to assist the community in implementing the Recommended Actions of this plan for which no current funding or support exists,
- Monitor implementation of this Plan,
- Report on progress and recommended changes to the City/County Manager's Office, and
- Inform and solicit input from the public.

The Committee will not have any powers over City/County staff; it will be purely an advisory body. Its primary duty is to see the plan successfully carried out and to report to the City/County Manager's Office and the public on the status of plan implementation and mitigation opportunities in the Peninsula communities. Other duties include reviewing and promoting mitigation proposals, hearing stakeholder concerns about hazard mitigation, passing the concerns on to the appropriate entities, and posting relevant information on the community's website.

7.1 Maintenance

Plan maintenance implies an ongoing effort to monitor and evaluate the implementation of the plan, and to update the plan as progress, roadblocks, or changing circumstances are recognized. This monitoring and updating will take place through an annual review by the Committee and a five-year written update to be submitted to the state and FEMA Region III, unless disaster or other circumstances (e.g. changing regulations) lead to a different timeframe.

When the Committee convenes for the review, they will coordinate with all stakeholders that either participated in the original planning process, or have joined the Committee since the inception of the planning process. The goal will be to update and revise the plan. Public notice will be given and public participation will be encouraged. The invitation to participate will be extended via web-postings and press releases to the local media outlets.

The evaluation of progress can be achieved by monitoring changes in the vulnerability identified in the Plan. Changes in vulnerability can be identified by noting:

- Lessened vulnerability as a result of implementing Recommended Actions;
- Increased vulnerability as a result of failed or ineffective mitigation actions; and/or,
- Increased vulnerability because of new development.

The updating of the plan will be accomplished through written changes and submissions as the Committee deems necessary, and as approved by the governing bodies of each community.

Appendix A

Hazard Mitigation Planning Committee Member List

Hazard Mitigation Planning Committee Member List

Community	First Name	Last Name	Title	Agency
Hampton	James	Freas		Planning Dept.
	Libby	Griebel		Senior Appraiser
	Allan	Lambert		GIS Manager
	David	Langille		Chief Inspector
	Jim	Redick	Deputy E. M. Coordinator	Emergency Mgmt
	Tammy	Waldroup	Assistant Planner	Planning Dept.
	Donald	Whipple		Senior City Planner
Newport News	Carol	Caldwell	Codes Compliance	
	David E.	Gossett	Self-Insurance Programs, Admin.	Self-Insurance Programs
	Mark	Hargrave	GIS Supervisor	Dept. of Engineering
	Ralph	Harris	Senior Appraiser	Real Estate Assessor
	Kenny	Holloway	Street Division, Asst. Admin.	Public Works, Street Div
	Kathy	James-Webb	Planner, Senior	Dept. of Planning
	Doug	Kennedy	Superintendent of Landscape Services	Parks & Recreation
	Kris E.	Keyes	Human Resources Manager	Waterworks
	Eric	Lamberton	Public Works, Asst. Director	Public Works
	Theresa	Lazar	Deputy Coordinator	Office of Emergency Management
	Lou	Marks	Codes	Codes Compliance
	Antonio	Risk	Engineering, Senior Tech.	Public Works
	Harold	Roach	Codes	Codes Compliance
	Emily	Seward	Planner, Emergency	Emergency Management
	Joe	Street	City Assessor	Real Estate Assessor
	Dick	Tyson	Shelter Coordinator	Public Schools
	David	Watson	Environmental Planner	Dept. of Planning
	Deirdre	Wells		Engineering
	Andrew S.	Wilks	Property Manager	Department of Development
Williamsburg	Jason	Beck	Zoning Officer	Planning
	Bert	Geddy	Fire Chief, Deputy & Deputy Coord	Williamsburg Fire Dept
	Cindy	Greczek	Colonial Williamsburg	Deputy Dir. Of Safety
	Bob	Iversen	Utilities Superintendent	Utilities
	Robert	Johnson	Fire Safety Officer	Facilities Management
	Ted	Lyman		GIS Consultant
	John	Mattson		City Assessor
	Jim	Murphy		Deputy Coord.
	Lori	Rierson	Recreation Dept.	Deputy Director
College of William & Mary	Larry	Richards	Safety & Environmental Health	Assc. Director of Safety
William & Mary	Jack	Williamson	Emergency Mgmt, Coordinator	Emergency Management
W'burg-JCC Schools	Jay	Sexton		Williamsburg Police
James City County	George	Adams	Utility Operations Administrator	JCSA

Community	First Name	Last Name	Title	Agency
	Wilton	Bobo	Emergency Services	Deputy Coord.
	Ellen	Cook	Planner	Development Management
	Pat	Foltz	GIS, Development Tech.	Development Management
James City County	Emmett H.	Harmon	Deputy Chief of Police	County Police Department
	Kim	Hazelwood		GIS
	Jane	Leonard	Administrative Services Coordinator	James City County
	A. Vaughn	Poller	Planner, Community Dev.	JCC Office of Housing & Community Development
	Doug	Powell	Assistant Manager	Community Services
	Bob	Ryalls		
	Matt	Smolnick		
	Alan	Robertson	Facilities Manager	W'burg JCC Schools
York County	Connie	Bennett	Stormwater Engineer	Env'l & Development
	Timothy	Cross	Planner, Principal	Planning Division
	Jim	Dishner	FM, Asst. Chief, Dep Coord	York Co. Fire Dept.
	Marianne G.	Harris	Building Code Official	Building Regulation
	Korine	Leonard	GIS Supervisor	York County
	Al	Maddalena	Chief of Development & Compliance	Development & Compliance
	Amy	Parker	Planner, Senior	Planning Division
	Stephanie	Peters	GIS Analyst	York County
	Judith N.	Riutort	Emergency Mgmt, Deputy Coord.	Fire & Life Safety
	Greg	Thacker		County Assessor
HRPDC	Tammy	Kaarlgard	HRPDC	Planner
Langley AFB	MSGT Darryl	Hart	USAF	1st Civil Engineering
State of Virginia	Hibak	Hersi	Va. Dept. of Emerg. Mgmt.	Local Haz. Mit. Planner
State of Virginia	Brittany	Schaal	Va. Dept. of Emerg. Mgmt.	Local Haz. Mit. Planner

Appendix B

Hazard Specific Mapping

B-2 – B-4 Peninsula Hurricane Tracks
B-5 Peninsula Tornados, 1950-2002
B-6 Landslide Hazard Map

Peninsula Hurricane Tracks, 1851-1899

Hurricanes Passing Within 25 Nautical Miles of Newport News, VA

Year	Month	Day	Storm Name	Wind Speed (Kts)	Pressure (Mb)	Category
1854	September	10	not named	40	not available	Tropical Storm
1856	August	19-20	not named	50	not available	Tropical Storm
1859	September	17	not named	50	not available	Tropical Storm
1861	September	27	not named	60	not available	Tropical Storm
1863	September	18	not named	50	not available	Tropical Storm
1872	October	25-26	not named	40	not available	Tropical Storm
1874	September	29	not named	50	not available	Tropical Storm
1877	October	4	not named	50	not available	Extratropical
1881	September	10	not named	50	not available	Tropical Storm
1882	September	11	not named	40	not available	Tropical Storm
1882	September	23	not named	40	1005	Tropical Storm
1886	July	2	not named	35	not available	Tropical Storm
1889	September	24-25	not named	40	not available	Tropical Storm
1894	October	10	not named	60	not available	Tropical Storm

Source: NOAA CSC Hurricane Mapping Tool

Peninsula Hurricane Tracks, 1900-1949

Hurricanes Passing Within 25 Nautical Miles of Newport News, VA

Year	Month	Day	Storm Name	Wind Speed (Kts)	Pressure (Mb)	Category
1902	June	16	not named	40	not available	Extratropical
1904	September	15	not named	55	not available	Tropical Storm
1924	September	30	not named	35	not available	Extratropical
1928	August	12	not named	30	not available	Extratropical
1928	September	19	not named	40	989	Tropical Storm
1933	August	23	Chesapeake-Potomac Hurricane	60	971	Tropical Storm
1944	October	20-21	not named	35	996	Tropical Storm

Source: NOAA CSC Hurricane Mapping Tool

Peninsula Hurricane Tracks, 1951-2004

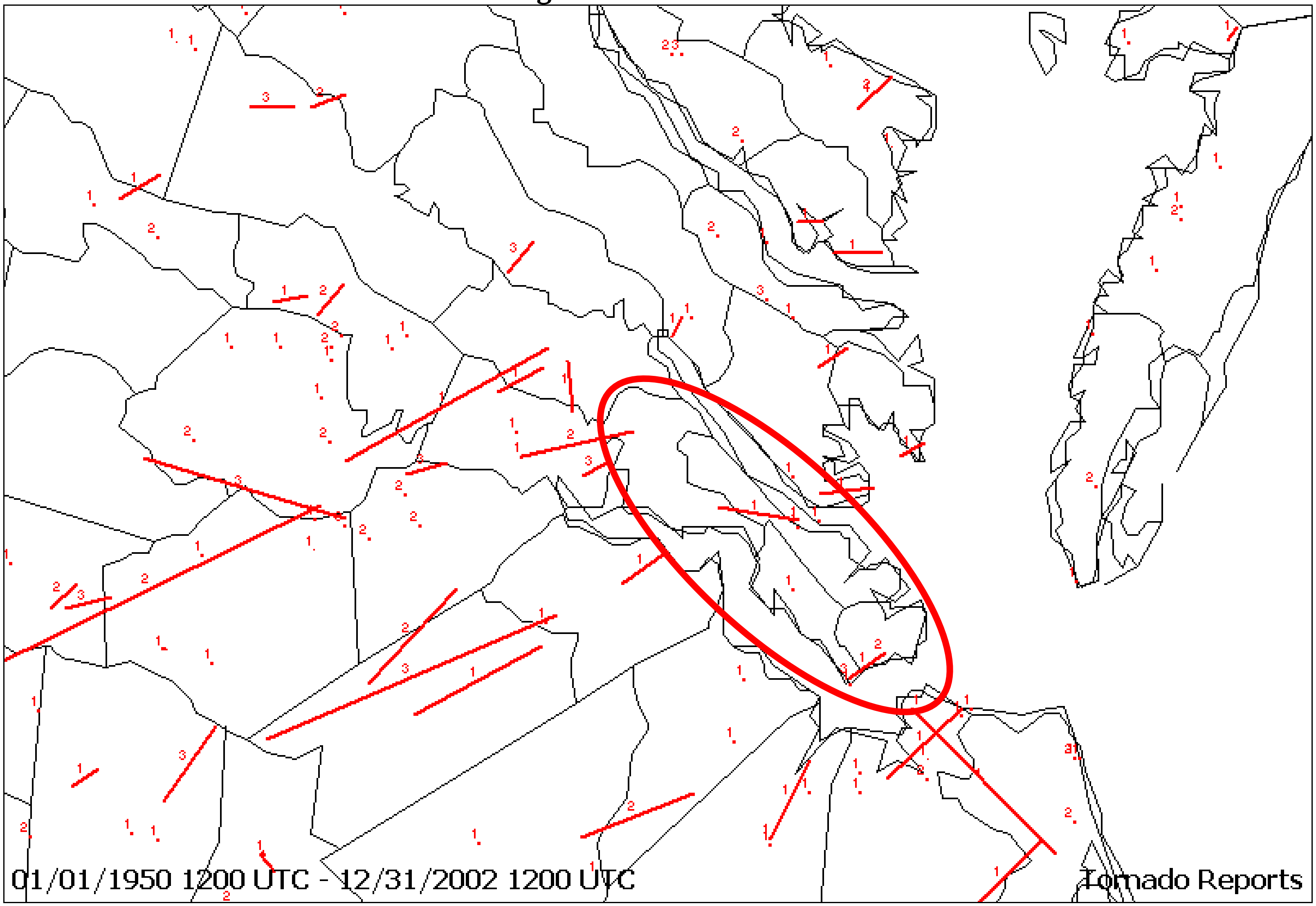
Hurricanes Passing Within 25 Nautical Miles of Newport News, VA

Year	Month	Day	Storm Name	Wind Speed(Kts)	Pressure(Mb)	Category
1959	July	10	Cindy	30	0	Tropical Depression
1960	July	30	Brenda	50	0	Tropical Storm
1961	September	14	not named	35	0	Tropical Storm
1969	August	20	Camille	25	0	Tropical Depression
1970	May	27	Alma	25	1003	Extratropical
1971	August	28	Doria	55	0	Tropical Storm
1971	October	2-3	Ginger	30	0	Tropical Depression
1979	July	14-15	Bob	20	1010	Tropical Depression
1981	July	1	Bret	30	1006	Tropical Depression
1985	August	19	Danny	25	1012	Extratropical
1996	July	13	Bertha	60	993	Tropical Storm
1999	September	16	Floyd	70	967	Hurricane – Category 1
2004	August	30-31	Gaston	30	1002	Tropical Depression

Note: The eye of Hurricane Isabel (2003) did not pass within 25 nautical miles of the Peninsula and, therefore, does not appear in this database or mapping.

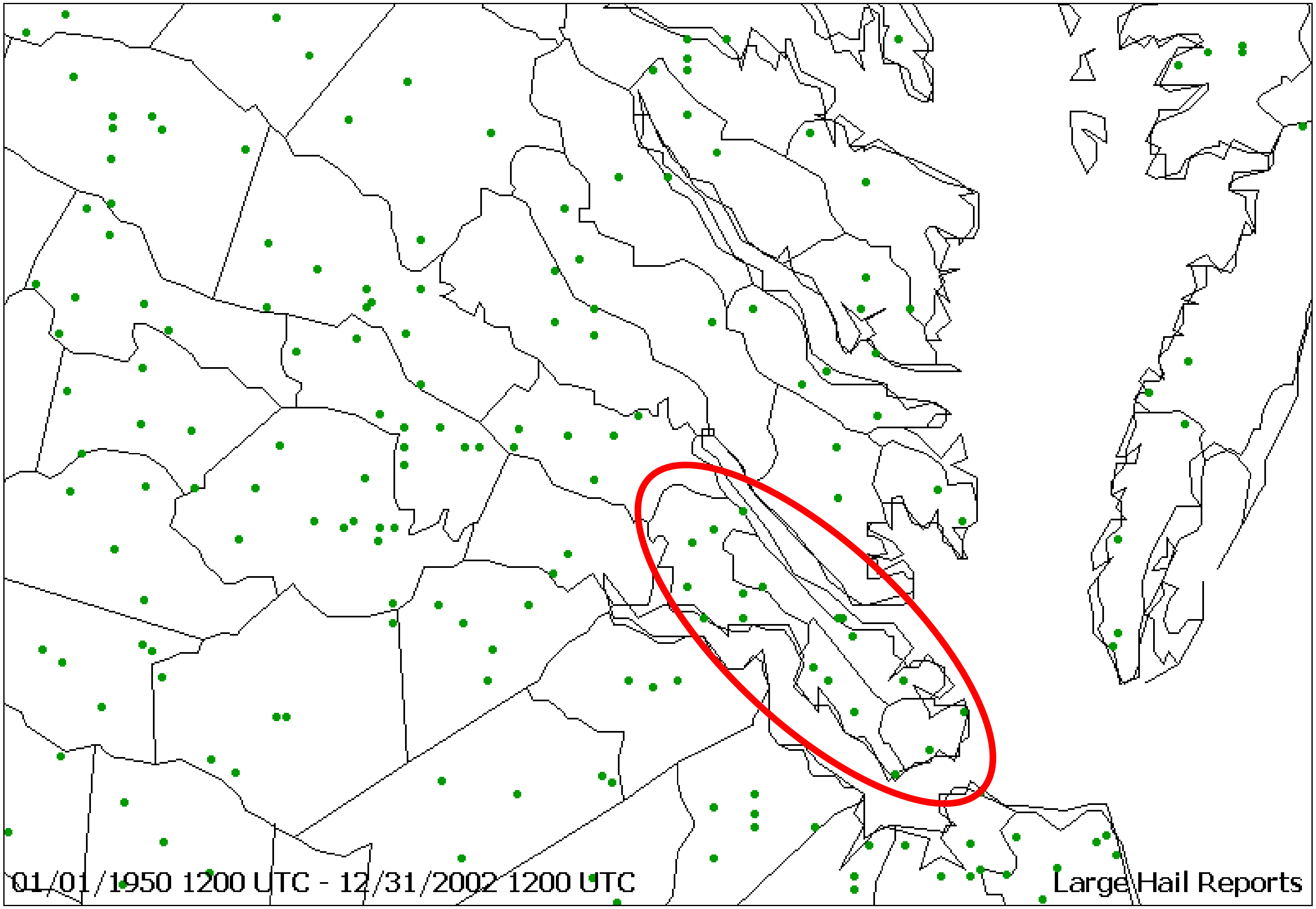
Source: NOAA CSC Hurricane Mapping Tool

Peninsula Reported Tornado Tracks, 1950-2002
Magnitude F1 or Greater



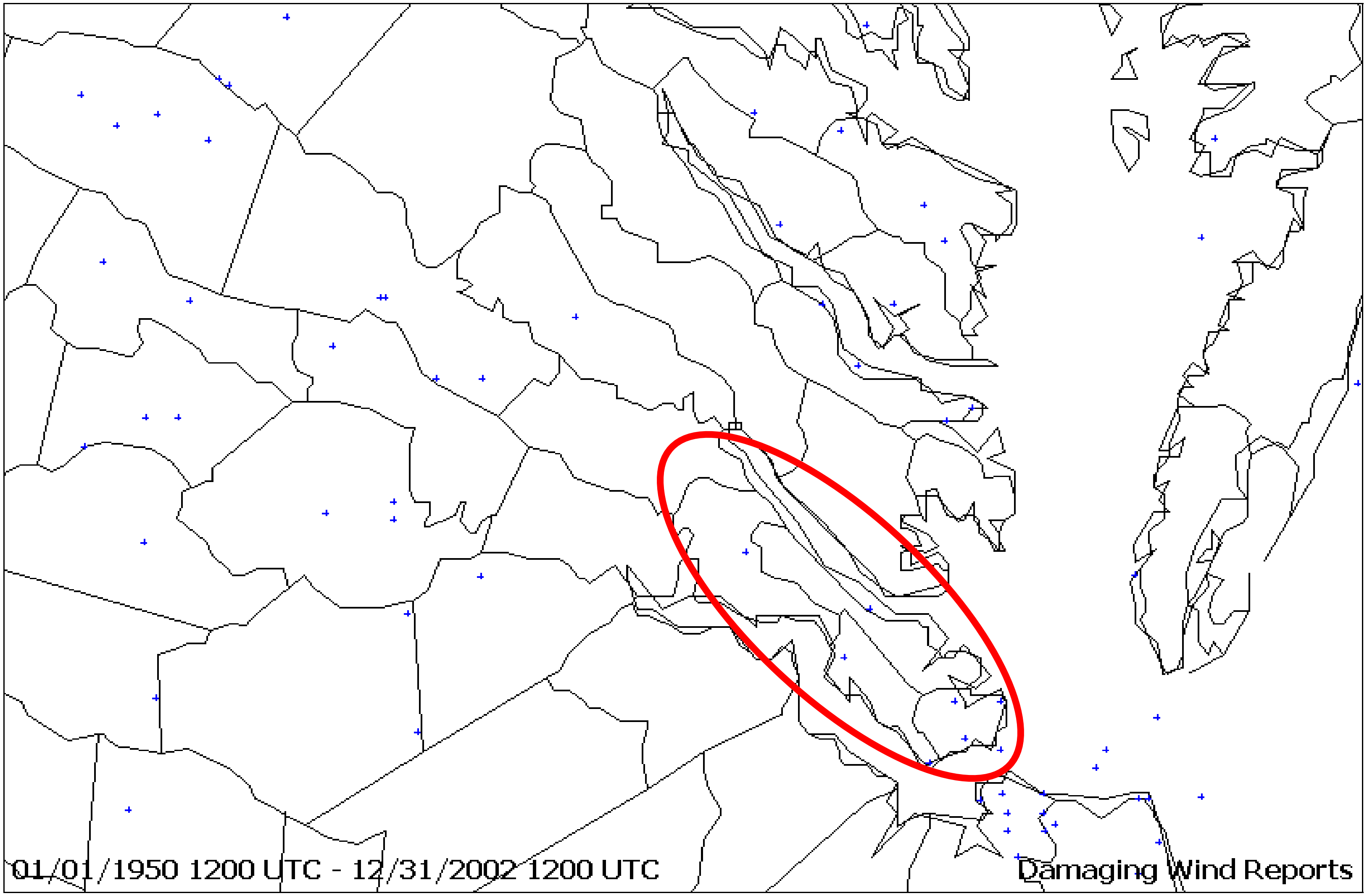
Source: NWS SVRPLOT Output

Peninsula Large Hail Reports, 1950-2002
Hail Greater than 1 inch



Source: NWS SVRPLOT Output

Peninsula Damaging Wind Reports, 1950-2002
Sustained Wind Greater than 60 knots



Source: NWS SVRPLOT Output

Appendix C
Catalog of Virginia's Historical Hurricanes

Catalog of Virginia's Historical Hurricanes

The following catalog has been compiled from records of the National Weather Service, Wakefield Office (www.erh.noaa.gov/akq), and a web site on *Virginia's Hurricane History* researched by David Roth with the Hydrometeorological Prediction Center in Camp Springs, Maryland, and Hugh Cobb, with the National Weather Service Forecast Office in Wakefield, Virginia (http://www.hpc.ncep.noaa.gov/research/roth/vahur.htm).

Continuous weather records for the Hampton Roads Area of Virginia began on January 1, 1871 when the National Weather Service was established in downtown Norfolk. The recorded history of significant tropical storms that affected the area goes back much further. Prior to 1871, very early storms have been located in ship logs, newspaper accounts, history books, and countless other writings. The residents of coastal Virginia during Colonial times were very much aware of the weather. They were a people that lived near the water and largely derived their livelihood from the sea. To them, a tropical storm was indeed a noteworthy event. The excellent records left by some of Virginia's early settlers and from official records of the National Weather Service are summarized below. Learning from the past will help us prepare for the future.

SIXTEENTH CENTURY

Note: Dates before September 2, 1752 converted from the Julian to the Gregorian calendar

The Spanish were becoming nervous about French activity in the New World, particularly along the Atlantic coast. This worried the Spanish because they used the Gulf Stream to move their plunder from old Mexico and Florida back to Spain. King Phillip II demanded the settlement of the coast in 1558, leading to the first explorations of the region around Virginia (Lewis & Loomie).

1564 The Native American population of the area told of a shipwreck during that year. A "christian shippe" was beaten by a storm; none aboard survived the ordeal. The natives made instruments from the nails and spikes off the vessel. (Chapman)

1566 June 14 (Old Style): Four vessels of Angel Villafañe's fleet were passing offshore Hatteras. On the 14th, two small vessels perished, while Villafañe's caravel nearly foundered. The remaining two vessels eventually made their way to Havana (Lewis & Loomie).

1586 June 23-26 Sir Francis Drake arrived near Roanoke Island, only to be greeted by a storm. It was described as "extraordinary" and lasted three days. His fleet was in great danger during the tempest. The Primrose broke its 250-pound anchor. Hail the size of hen eggs pelted the colony. Waterspouts also threatened the mariners. The settlers evacuated back to England soon after the storm.

1587 August 31 Admiral Drake encountered a hurricane at Roanoke Island during the following year. Strong northeast gales caused him and his crew to "cut his cables" and set out to sea. It took six days to regroup after this treacherous storm.

1591 August 26 Roanoke Island was again struck by a severe storm. The winds blew out of the northeast, directly into the harbor. Waves crashed on a sandbar and currents in the area became quite dangerous.

SEVENTEENTH CENTURY

1609 August 4 (The Tempest): Sir Thomas Gates, future governor of Virginia, was on his way to England from Jamestown. On Saint James Day, while between Cuba and the Bahamas, a "most terrible and vehement storm" raged for 44 hours. One of the small vessels in the fleet sank to the bottom of the Florida Straits. Four of the remaining vessels reached Virginia soon after the storm...followed a few days later by three other ships.

The flagship, known as Sea Adventure, disappeared and was presumed lost. A small bit of fortune befell the ship and her crew when they made landfall on Bermuda. Although the vessel was damaged on a surrounding coral reef, all survived and spent ten months on the unsettled isle. The Spaniards, though shipwrecked on the island many times, had failed to colonize there.

The British claimed the island and quickly settled the subtropical isle. In May 1610, they set forth for Jamestown, this time arriving at their destination. This near catastrophe provided the inspiration and background for William Shakespeare's play, The Tempest.

1635 August 24: First historical reference to a major hurricane that could have affected the VA coast. A major hurricane affected the Virginia coast as it moved to the east of the colony. Despite its impact in New England, no references to damage in Virginia has been found.

1649: A "great storm and tide" destroyed a large quantity of tobacco stored in various rolling houses (Chapman).

1667 September 6 (The "dreadful hurricane of 1667"): It appears likely this hurricane caused the widening of the Lynnhaven River. The Bay rose 12 feet above normal and many people had to flee.

This system is considered one of the most severe hurricanes to ever strike Virginia. On the first, this same storm was reported in the Lesser Antilles. The hurricane devastated St. Christopher as no other storm had done before. The "great storm" went on to strike the northern Outer Banks of North Carolina and southeastern Virginia. The wind turned from the northeast to due south and finally to the west, which suggested a track similar to the August 1933 hurricane, a benchmark storm for the Hampton Roads area in the 20th century (see page 33). This 1667 hurricane lasted about 24 hours and was accompanied by very violent winds and tides.

Approximately 10,000 houses were blown over. Area crops (including corn and tobacco) were beat into the ground. Many cattle drowned in area rivers and bays by the twelve foot storm surge and "many people had to flee." The foundations of the fort at Point Comfort were swept into the river. A graveyard of the First Lynnhaven parish church tumbled into the waters. Twelve days of rain followed this storm across Virginia. This system is blamed for the widening of the Lynnhaven River. Ships in regional rivers sustained great damage.

> Several accounts attest to the fury of this great storm. The first was published in London from Strange News from Virginia. Sir having this opportunity, I cannot but acquaint you with the relation of a very strange tempest which hath been in these parts (with us called a hurricane) which had began August 27th (September 6th Julian calendar) and continued with such violence, that it overturned many houses, burying in the ruines much goods and many people, beating to the ground such as were any wayes employed in the fields, blowing many cattle that were near the sea or rivers, into them., whereby unknown numbers have perished, to the great afflication of all people, few having escaped who have not suffered in their persons or estates, much corn was blown away, and great quantities of tobacco have been lost, to the great damage of many, and utter undoing of others. Neither did it end here, but the trees were torn up by the roots, and in many places whole woods blown down so that they cannot go from plantation to plantation. The sea (by the violence of the wind) swelled twelve feet above its usual height drowning the whole country before it, with many of the inhabitants, their cattle and goods, the rest being forced to save themselves in the mountains nearest adjoining, while they were forced to remain many days together in great want.

The tempest, for the time, was so furious, that it hath made a general desolation, overturning many plantations, so that there was nothing that could stand its fury.

The following is a letter from Secretary Thomas Ludwill to Lord Berkeley on the subject of this "dreadful hurry cane" of September 6th gives added information about the cyclone:

> Jamestown Colony - this poore country is now reduced to a very miserable condition by a continental course of misfortune. On the 27th of August followed the most dreadful Hurry Cane that ever the Colony (Jamestown) groaned under. It lasted 24 hours, began at North East and went around northerly till it came to west and so it came to Southeast where it ceased. It was accompanied with a most violent rain but no thunder. The night of it was the most dismal time I ever knew or heard of, for the wind and rain raised so confused a noise, mixed with the continued cracks of failing houses.....The waves were impetuously beaten against the shores and by that violence forced and as it were crowded into all creeks, rivers and bays to that prodigious height that it hazarded the drowning of many people who lived not in sight of the rivers, yet were then forced to climb to the top of their houses to keep themselves above water. The waves carried all the foundations of the Fort at Point Comfort into the river and most of furnished and garrison with it.....but then morning came and the sun risen it would have comforted us after such a night, had it not lighted to us the ruins of our plantations, of which I think not one escaped.

> The nearest computation is at least 10,000 houses blown down, all the Indian grain laid flat on the ground, all the tobacco in the fields torn to pieces and most of that which was in the houses perished with them. The fences about the corn fields were either blown down or beaten to the ground by trees which fell upon them.

The storm passed inland northeast of Jamestown into northern Virginia. A severe storm in Manhattan on the 8th was most likely a continuation of this cyclone, as it recurved northeast. Another hurricane may have passed very close to the Virginia coastline on September 10th since the "dreadful hurricane of 1667" was accompanied by twelve days and nights of rain. A second storm passing close to the Virginia coast would have extended the period of rain.

1669 August 18: This hurricane struck the northern Outer Banks of North Carolina, and most likely affected Virginia.

1683 August 23: A hurricane which made landfall in Virginia caused a tremendous flood in the Connecticut Valley.

1683 September 5-10: William Dampier, a sailor and buccaneer, gave a "vivid account" of a hurricane in the North Atlantic, three days after leaving Virginia. He addressed it in his chapter titled "Discourse of the Trade-Winds, Breezes, Storms, Seasons of the Year, Tides and Currents of the Torrid Zone throughout the World," published between 1703 and 1705. This writing became a classic of maritime literature (Ludlum).

1693 October 29: From the Royal Society of London, “There happened a most violent storm in VA which stopped the course of ancient channels and made some where there never were any.” The great storm was violent as it passed through Accomack, which was located on the Delmarva peninsula between Chesapeake Bay and the Atlantic, sixty miles northeast of Norfolk. This storm may have created Fire Island Cut, to the east of New York City.

EIGHTEENTH CENTURY

1703 October 18: A hurricane caused great damage along the Mid-Atlantic coast. In Maryland and Virginia, many vessels left their moorings. Ten tobacco houses were overturned. Damage occurred northward to Philadelphia. Across the Northeast, northeast winds caused a very cold rain to fall. The timing of this storm was quite unusual, as it followed a very early season snowstorm by eight days.

1706 November 6: A severe storm raged offshore of Virginia before it swept up the coast. A fleet met the storm soon after departing the Virginia shore. Fourteen ships foundered on the north coast of Cape Charles; those ships that returned sustained extensive damage to masts and sails.

1713 September 17: A great storm attended by immense inundation affected the Carolinas and Virginia. The effects were most significant in Currituck county, North Carolina near the Virginia-North Carolina border, where the storm surge breached the Outer Banks and opened several inlets into the Currituck Sound. William Byrd, one of the commissioners who established the Virginia-North Carolina boundary, stated

"....There was no tide in Currituck until 1713, when a violent storm opened a new inlet five miles south of the old one, since which convulsion the old inlet is almost choked up by the sand, and grows narrowed and shallower everyday"

One of the new inlets carved out by the storm became the location where the Virginia-North Carolina line begins on the Atlantic coast.

1724 August 23 (Great Gust of 1724): Almost all tobacco and much of the corn crops were destroyed by a violent tropical storm, which struck Chesapeake Bay. "Violent floods of rain" and "prodigious gust of wind" were seen upon the James river. Some homes were wrecked and several vessels were driven ashore (Ludlum). One ship was wrecked while on the James river. It may have been followed by a second tropical cyclone on the 28th, as rains continued in Virginia for days.

1747 September 15: The next report of a hurricane in the area came twenty three years after the "Great Gust". A ship load of indentured servants, whose goal was to cross the Atlantic and pay for it with years of servitude, was lost in the Rappahannok river. She was struck just south of Urbanna by a "sudden violent hurricane" and immediately capsized. More than fifty drowned during the storm (Shomette).

1749 October 19: A tremendous hurricane tracked offshore Virginia, northeast to Cape Cod. At 1:00 a.m. at Norfolk, winds became violent from the northeast. The fury of the storm peaked between 10:00 a.m. and 2:00 p.m.. In Williamsburg, one family drowned as flood waters carried their house away. At Hampton, water rose to four feet deep in the streets; many trees were uprooted or snapped in two. Torrents of rain flooded northern Virginia and Maryland. The Bay rose to fifteen feet above normal...destroying waterfront buildings.

An account of this tremendous storm was given in the biography of Commodore James Barron, *An Affair of Honor*, by William Oliver Stevens. Barron's grandfather witnessed the hurricane first hand while stationed at Fort George. The account is as follows:

> A threatening sky was observed to the southeast over the Chesapeake Bay. The wind increased which soon brought the rain. As the hours wore on the wind and rain increased in fury. Sometimes the downpour slackened. One could hear the sand picked up by the wind from the beach outside and blasted against every object that still withstood the gale. All the while the rising tide was rapidly being piled up to a height never seen before in that area. The waves were pounding on the shore, finally to the very foot of the outside wall at Fort George. A large tree crashed over on its side with its roots in the air and was driven against the land side of the Fort. With the impact the wall yawned and broke. Shortly afterwards the seawall lurched and sank at the point where it was exposed to the wave fury of the storm. Finally the outside wall of the fort gave way, and the filling of sand poured out, leaving the inner wall exposed to the blast without support. When this too fell apart and collapsed, the barracks took the full force of the wind. About sundown, the storm slackened and in another hour the rain and wind had diminished to such a degree that it was clearly spent.

The next morning Commodore Barron swept the distant waters with his spy glass. He was astonished to see across Hampton Roads a wide, sand promontory which had not existed there before. A sand spit had been thrown up during the fury of the storm, which was the beginning of Willoughby Spit.

Another account of the storm given by a letter written at Annapolis, Maryland describes the storm as such:

"....On Saturday October 18th, the wind began to blow hard and by 1:00 a.m. (The 19th) was very violent from the northeast with rain. The hardest portion of the storm occurred from 10 a.m. to 2 p.m. on the 19th. The bay (Chesapeake) rose 15 feet perpendicular, according to one witness. The tide kept fluxing and ran some small craft nearly a mile from common high water and left some in cornfields.

At least four ships were destroyed at the south end of Chesapeake Bay (Shomette). Bodies washed ashore from the shipwrecks for days afterward. Damage in the area totaled £30,000...as currency of the colonies was British. Benjamin Franklin was keeping an eye on this one. It confirmed his hypothesis, the first of its kind, that storms along the coast moved from southwest to northeast (Ludlum).

1752 October 22: A storm caused great damage in southern Chesapeake Bay. Only one ship, named *Peggy and Nancy*, was lost during the northeast gale. She was driven ashore on Willoughby Point at 10:00 p.m.. The ship broke up in the morning; only the sails, rigging, and five of her original 338 hogsheads of tobacco could be recovered (Shomette).

1761 September: A hurricane of great strength raked the Virginia and North Carolina coasts. The schooner *Good Intent* was overtaken by the storm just after entering the Chesapeake Bay. This storm also carved a new inlet on the northern Outer Banks of North Carolina.

1761 October: A major hurricane brushed Cape Hatteras and remained east of the Virginia Capes.

1766 September 11: A hurricane struck the Virginia coast.

1769 September 7-8: Considered one of the worst storms of the Eighteenth century, this hurricane passed over Williamsburg. Winds increased at 1:00 a.m., blowing a violent gale between 10 and 11 a.m.. Winds increased out of the northwest and continued "until dinnertime". Many old homes and trees were leveled. Heavy rain ruined tobacco crops and flooded roads. Tobacco in storage was also damaged at the warehouse.

Heavy damage was seen in Chesapeake Bay. High winds tore off the top of a wharf at Yorktown; a schooner rammed a nearby storehouse. Four ships in the York river were driven ashore. Two ships on the James River were also wrecked. A vessel from Norfolk, filled with coal from Williamsburg, was forced up to Jamestown before it went to pieces. At least six perished due to shipwreck. The storm tracked northeast along the coast, accelerating as it passed by New England and into Canada.

1772 September 1: A tropical storm forced fourteen vessels ashore at Ocracoke Bar in North Carolina with 50 persons perishing. It is likely this storm caused significant winds in southeastern Virginia.

1773 August 26: The Virginia Gazette reported a storm in Virginia.

1775 August 29-September 2 (The Independence Hurricane): This savage hurricane raged from North Carolina to Newfoundland. Heavy rains began to fall across the colony on the 29th of August and slowly increased with time. The coast was ravaged from Currituck to Chincoteague. Wharves and storehouses on the waterfront of Norfolk were devastated. Bridges were carried away by the raging waters. At Williamsburg, mill dams broke and corn stalks were blown flat. Winds blew furiously until 10:00 p.m.

Many ships were damaged as they were thrown ashore at Norfolk, Hampton, and York. Around twenty-five vessels were run ashore, or "irrecoverable gone." The gun ship *H.M.S. Mercury* was driven hard aground on Portsmouth Point at 5:00 p.m. on the 2nd. It was stranded in two feet of water for eight days (Shomette). The *Liberty* became "hopelessly stranded" in Back River, near Hampton. A number of locals boarded her, captured the crew, secured her goods, and set the ship afire in the first outright act of war. A full blockade of Hampton Roads thereafter brought shipping to a halt for three months. At least twenty-five died due to shipwreck.

1776 July 10: A strong gale played a role in a battle between the Royal Governor of Virginia, Dunmore, and General Lewis of the rebel forces. The royal fleet had been injured prior to the storm by General Lewis' forces and was sailing from Gwynn's Island toward St. George's Island, in the Potomac. The British crew was without water and enduring smallpox when the gale struck.

A flour-laden supply ship ran aground. One ships foundered at the Mouth of the Rappahannock, while another was stranded on the Eastern shore (Shomette). The *H.M.S. Otter*, the Governor's ship, was rescuing another ship in distress. They were rescued just in time. After loading the distressed ship's cargo, the ship sunk. The governor later left Virginia for good on August 5th. Many ships in the area suffered damage to their rigging, sails, and anchors. Two vessels were driven ashore in St. Mary's county (Shomette).

1777 August 10: A storm of tropical origin affected the North Carolina and Virginia coasts.

1778 August 12: A hurricane passed quite near the Virginia coast generally on a track which extended from Charleston, South Carolina through New Bern, North Carolina and was next detected in southeastern New England. It prevented a major naval battle between the British and the French during the American Revolution.

1781 August 11: A gale prevailed for forty hours at Wilmington, North Carolina moving slowly northward just inside the coastline. This storm probably affected Virginia as well.

1781 October 16: A storm of "unknown character" struck Virginia. The Earl of Cornwallis, at Yorktown, was trapped by the French Fleet and the Patriot Army, under the command of George Washington. The Earl decided to flee to the north to Gloucester Point under the cover of darkness. A "furious storm" doomed the plan to failure, as seas ran high and every boat was "swamped". He sent forward his flag of truce and surrendered, thus ending the battle (Chapman).

1783 October 8: The first of three major storms to affect the East coast that month made landfall near Charleston on the 7^{th}. At Richmond, violent winds blew in from the northeast for 24 hours. Norfolk saw a 25 foot rise in the tide, which caused damage there and at Portsmouth totaling around £9000. The reference to 25 foot tides was probably more of a reference to wave heights. This cyclone moved offshore New Jersey and continued past Providence, Rhode Island.

1785 September 22-24: The "most tremendous gale of wind known in this country" passed over the Lower Chesapeake Bay and went along a track very similar to the Chesapeake-Potomac Hurricane of 1933. At Norfolk, lower stories of dwellings were flooded. Warehouses were totally carried away by the storm surge, causing large amounts of salt, sugar, corn, and lumber to disappear. A large number of cattle drowned, and people hung onto trees for dear life during the tempest. At Portsmouth, the entire town was submerged. Forrest's book, Sketches of Norfolk, offers this account of the storm:

"....This year, 1785, was noted for the highest tide ever before known to Norfolk, completely deluging a large portion of its site on the water side".

Almost all ships in the area were driven from their moorings near Norfolk. Many ships were dismasted as well. The brig *Nancy*, coming from Madiera with a cargo of wine, was dashed to pieces on the Virginia Capes. Only two aboard survived the ordeal. The sloop *Phobe* lost its bowsprit and was laid upon her beam ends. A Dutch ship was found fully loaded, with no one aboard. Vessels floated inland into cornfields and wooded areas. No less than 30 vessels were seen beached after the storm. Damages totaled £30,000. At least two died due to shipping disasters. After ravaging Virginia, the system tracked up the coast to Boston.

1788 July 23-24 (George Washington's Hurricane): This storm originated near Bermuda on the 19^{th} before making landfall in Virginia. It passed directly over the Lower Chesapeake Bay and Mount Vernon, the home of George Washington. This track is very similar to the track of the Chesapeake-Potomac hurricane of 1933. At Norfolk, winds increased at 5 p.m. on the 23^{rd} with the wind originating from the northeast. At 12:30 a.m., the wind suddenly shifted to the south and "blew a perfect hurricane, tearing down chimneys, fences"...some corn was also leveled. In addition, large trees were uprooted and houses were moved from their foundations.

Port Royal and Hobb's Hole experienced a violent northeast gale which drove several vessels ashore. In Fredricksburg, great quantities of corn, tobacco, and fruit were destroyed. Houses and trees fell in great numbers across Northumberland, Lancaster, Richmond, and Westmoreland counties. Crops were destroyed and many livestock perished in Lower Mathews county. Many plantations saw their houses leveled. Homes were flooded with water six feet deep... several inhabitants drowned. Gloucester county was inundated, $400,000 in damage was incurred.

Historical figures of the time logged the storm's antics. George Washington noted the sinking of the small ship *Federalist* and uprooted trees. Colonel James Madison, father of the future president, experienced the passing of great winds and rains near Orange. In Alexandria, damage to wheat, tobacco, and corn was "beyond description" (Ludlum).

The schooner *Patriot* was stranded and bilged near Portsmouth. The schooner *Serenity* was driven aground at the Portsmouth distillery, proving a total loss. A newly constructed brig, most likely the *Neptune*, was lifted up from here moorings and left in the main street of town. The *Mermaid* was dismasted. The *Favorite* was completely destroyed at Hampton Roads...only two ships in Hampton Roads escaped the hurricane. Many small craft were "torn to pieces".

1795 August 2: A hurricane which passed through North Carolina passed to the south of Norfolk. A ship foundered off Cape Charles. Heavy rains in northwestern Virginia flooded Winchester and Martinsburg. Roads were impassable beyond Baltimore, disrupting mail service. A large amount of corn and hay were in ruin. Mills and mill dams were swept away. Great damage was noted across Culpeper and Orange counties. It then recurved across Maryland and passed south of New York City to Halifax. Several vessels were lost off Norfolk. The brig *Esther* was lost, with most of her cargo from Jamaica, twenty-five miles south of Ocracoke Bar.

1795 August 12-13: A major hurricane...only ten days after the previous storm...struck North Carolina and produced high winds as far inland as Winston-Salem. At Monticello, near Charlottesville, Thomas Jefferson noted that the loss of soil from the heavy rain thus far that month could be "modestly estimated at a year's rent" (Ludlum). A "powerful torrent of rain" deluged Petersburg; creeks were at their highest point of the past 70 years.

1797 September 5-6: A sloop was lost at Currituck Inlet on the 5th during a storm. The sloop *Betsy* was returning from Cape Hatteras during the 6th. In sight of the Cape Henry lighthouse, she "was obliged to bare away in a gale of wind" (Chapman).

NINETEENTH CENTURY

1803 August 29: The schooner *Jupiter* sprung a leak off the Virginia Capes in heavy seas during a storm off the Virginia Capes, before heading into the Chesapeake. As the ship was sinking, the captain jumped overboard, but was pulled into the whirlpool created by his sinking ship and drowned (Chapman).

1804 September 8 (Antigua-Charleston Storm): This system was first spotted near the Northern Leeward Islands on the 3rd and moved west-northwest, to very near the Florida coast. It then moved inland near Charleston with disastrous consequences, before moving northeast along the coast of the Atlantic Seaboard.

1804 October 9 (New England's Snow Hurricane of 1804): At Norfolk, winds shifted from Force 3 southwest (on the Beaufort scale) to Force 6 northwest by 2 p.m.. A schooner *Rising Stakes,* off Cape Henry, went through the "dreadful squall" at 11 a.m.. The system passed through Chesapeake Bay, then inland between Philadelphia and Atlantic City before moving onward to New York City and Boston. Eight perished offshore.

As it passed through the Northeast, it became a nontropical low as cold air rapidly enveloped the circulation of the cyclone. Snow fell from the hills of Connecticut northward into Canada. As much as 24 to 30 inches of snow fell in the Berkshires of Massachusetts...which in a wet snow could be approximated to six inches or more of liquid precipitation. This was the first reference to snow involved with a landfalling tropical cyclone, but not the last, as the reader will see later on in this history.

1806 August 21-23 (Great Coastal Hurricane of 1806): The appearance of the weather from the 20th indicated a nearby storm. Heavy squalls broke upon the bar off Norfolk. A hurricane which went inland in South Carolina took 36 hours to go through North Carolina. The system accelerated into the offshore waters of Virginia.

A gale developed out of the north-northeast on the 22nd before noon. At Norfolk, the wind blew with "great violence" out of the north between midnight and 3 a.m.. A considerable amount of rain fell. A "long and uncommon" drought in Petersburg was ended by the cyclone (National Intelligencer). This saved the corn crop. Several new buildings and chimneys were blown down. Two vessels were grounded.

The hurricane caught British and French ships off guard, while engaged in the Napoleanic Wars in the U.S. shipping lanes. The British man-of-war *L'Impeteax* drifted under jury masts for 23 days before finally beaching near Cape Henry. The ship *Atlantic* and brig *Martha Bland* were driven ashore. The vessels *Haleyon, Hope,* and the Revenue cutter schooner *Eagle* went ashore at James Island.

Ships of the two warring nations put in for repair and refitting at the port of Norfolk after the storm. This hurricane, due to its slow movement and consequent erosion of the coastline completed the creation of Willoughby Spit. A seawall built to prevent further erosion at Smith Point lighthouse was damaged.

1806 September 28-29: The first signs of the system were seen in Georgia, when several days of heavy rain fell at Augusta, Georgia on the 25th (National Intelligencer). Gales began from the northeast during the night of the 28th at

Norfolk. Winds became southeast in the morning before shifting to the west, as the center moved inland of the coastline. Tides rose "uncommonly high". The schooner *Charming Mary* fell victim four leagues north of Chincoteague, with many of her masts seen above the waterline after her sinking (Chapman).

1808 September 12: A hurricane again damaged the seawall surrounding Smith Point lighthouse. The ship *Mary* was destroyed during the gale, while anchored at Baltimore.

1813 August 27-28: A hurricane struck Charleston and spread gale force winds as far north as Maryland. An all-day easterly gale was seen in the Upper Chesapeake Bay on the 28th. A north-northeast wind began on the 27th. By 10 p.m., it shifted to southeast, accompanied by squalls. As winds became southwest, strong winds buffeted the region until 1 a.m. the 28th. By 11 a.m., winds were dying and the sun was shining once more. The U.S. schooner *Carolina* went ashore near James Island.

The War of 1812 was in progress. A large prison ship, with 50 passengers aboard composed of the British schooner *Dominico,* parted cables and was driven into the marsh of James Island by the gale (Chapman).

1814 August 24-25 (Burning of Washington): A very hot day accompanied the retreating of Federal troops from the Capitol. As Dolly Madison and an armed escort stopped in Tennallytown (Tenlytown) during their retreat, a strong wind accompanied by dark clouds rolled over Washington county. Winds near hurricane force and a prolonged downpour added to the drama of the day. The rains were helpful, as they helped firefighters quench the fires set by the British (Helm). The weather signs mentioned point to this either being a severe thunderstorm, or a tropical cyclone.

1815 October 24-26: On the 18th, a powerful hurricane struck St. Bartholomew in the Caribbean Sea. By the 24th, it progressed west and northwest to a position east of Chesapeake Bay. The schooner *Friendship* was knocked on her beam ends by unfriendly winds and seas. For 48 hours, the storm passed offshore, delaying ship arrivals into Norfolk with its strong northwest wind (Chapman).

1816 September 18: A tropical storm affected Virginia before moving northeast into New York. Heavy rains caused the James river in Richmond to rise only an inch or two lower than the High Fresh of 1814. Flood waters invaded the first floors of area homes. One bridge was submerged, cutting off travel (Chapman).

1817 August 8-9: A tropical storm with heavy rain moved through the state. At Norfolk, floods to the north delayed the passage of mail. The gale moved slowly northeast, reaching New York on the 12th. (Chapman)

1821 September 2-3 (Long Island Hurricane): One of the most violent hurricanes on record. A fast moving hurricane traveled from Puerto Rico to Norfolk in only two days. The storm passed by Turks Island in the Bahamas on the 1st. This hurricane moved inland near Wilmington, North Carolina the following day. The center then tracked west of Ocracoke but east of Edenton. In Currituck, N.C. all but a half dozen houses were destroyed and several people killed.

It was a "tremendous storm", causing great wind damage and damaging ships in the harbor. At Norfolk, rains began at 6 a.m.. By 8 o'clock, a northeast gale ensued and increased in intensity to hurricane force by 11:30. By 12:30 p.m., rains ended; conditions were beautiful by mid afternoon. An account from the *Norfolk Herald* described the storm as such:

> From half past 11:00 until half past 12:00, so great the fury of the elements, that they seemed to threaten a general demolition of everything within their reach. During that period the scene was awful. There was the deafening roar of the storm, with the mingled crashing of windows and falling of chimneys, while the rapid rise of the tide threatened to inundate the town. The continuous cataracts of rain swept impetuously along darkening the expanse of vision and apparently confounding the heaven, earth and seas in a general chaos; together with now and then a glimpse caught through the gloom, of shipping forced from their moorings and driven with rapidity, as the mind might well conjecture in such a circumstance to inevitable destruction. (Ludlum).

Trees were uprooted. Part of the front of the Episcopal church was blown in; its organ left in ruin. The courthouse was partially unroofed. Several new homes suffered complete destruction while many others experienced damage. The new stone bridge on Granby Street was damaged by the incessant banging of heavy timbers against it. The tides inundated the ground floors of all the warehouses on the wharf lining the Elizabeth River. The waters surged as far inland as Wide Water Street some several hundred yards from the river. The surging waters of the Elizabeth River swept away the bridge on Catherine Street. The drawbridge across the Elizabeth river was swept away. The U.S. Frigates *Congress* and *Gurriere* were grounded while numerous other brigs, schooners, and smaller ships suffered an untimely demise.

Crops were destroyed in the vicinity of Chesapeake Bay. At Chincoteague, waters surrounding the island were evacuated such that miles of sandbars lay exposed to the air, as winds were initially offshore. The following is an account of what happened next from Howard Pyles, written in 1876:

> “...then a dull roar came nearer and nearer, and suddenly a solid mass of wind and rain and salt spray leaped upon the devoted island with a scream. Great pines bent for a moment, then, groaning and shrieking, were torn from their centuried growth like wisps of straw and hurled one against another; houses were cut from their foundations and thrown headlong; and then a deeper roar swelled the noise of the tempest, and a monstrous wall of inky waters rushed with the speed of lightning toward the island. It struck Assateague, and in a moment half the land was a waste of seething foam and tossing pine trunks; and the next instant it struck Chincoteague, and in an unbroken mass swept away men and ponies like insects; rushing up the island, tearing its way through the stricken pine woods." (Barnes & Truitt)

At Pungoteage, a ten foot storm surge led to "unexampled destruction". Damage spread north with the storm into New York and New England over succeeding days. It was considered one of the most violent hurricanes on record... with damage totaling $200,000 in Virginia. Five drowned at Chincoteague.

1822 September 27-28: This hurricane struck Charleston, then moved through central North Carolina and western Virginia, accompanied by a "tropical deluge". Richmond had endured a long drought until this storm visited the region. "Very copious rains" and "equinoctial winds" quickly ended the drought. Flash flooding occurred on the James River, rising feet in depth in a matter of one hour (Washington Gazette). Mail south of Richmond was unable to be delivered for three days, as the storm rendered roads impassable. At Monticello, near Charlottesville, Thomas Jefferson's granddaughter noted that a violent storm broke branches and felled one of their willows. At Lynchburg, winds uprooted trees and toppled chimneys. Along the Staunton River, rains began on the 27th and continued until 9 a.m. the next day. The river rose to "the greatest height ever known" (Chapman).

1825 June 3-4: Forming before what is nowadays considered as the beginning of the hurricane season, a severe tropical storm tormented the Atlantic seaboard from Florida to New York City. It was first sighted near Santo Domingo on May 28th and moved across Cuba on June 1st. Gales began at St. Augustine as the cyclone approached U.S. soil on the 2nd, and at Charleston on the 3rd.

It raked Norfolk with "undiminished violence" for 27 hours from the morning of the 3rd, as the storm passed by to the east. The wind came in "flaws". Trees were uprooted. At noon on the 4th, stores on the wharves were flooded up to five feet in depth. High winds howled through Washington D.C.. Along with a cold rain, winds leveled crops. The storm then moved northeast past Nantucket on the 5th.

An account of the storm was given by Ann Waller Tazewell, wife of the then governor of Virginia in a letter to her son. She describes the storm as such

> **"**....The rain commenced on Friday morning (3rd), and continued pretty steadily all day, at night the wind blew so hard that this house rocked considerably. I was so much alarmed as to be unable to sleep but very little - I thought of my flowers, but could not expect anyone so much as to look after my cows or anything, as the rain fell in torrents, and the wind came in flaws, which made it like thunder yesterday (4th) the storm continued until five in the evening, there was a strong northwest wind all day, and the highest tide I ever saw in my life. The wind and tide together tore down all our enclosures at the other lot, upset our cow-house and then dashed it to pieces, tore up some of the wharf logs, upset the Temple there, and drifted it into the flower garden........We sat at the front windows witnessing the destruction all the time it was going on. Our front lot was two thirds covered by the tide. Some vessels that we saw pass rapidly by, were driven ashore at the Hospital Point (Portsmouth)........"

Ann Tazewell later compares the storm to the great gale of September 1821 in this following passage: "....Such a storm was never experienced here before, by anyone that I have heard speak of it. It is thought to have been far worse than the September gale of 1821." Mrs. Tazewell's letter also mentions that they could not prepare dinner since the tide level was even with the kitchen floor.

An account of the storm as given by the Norfolk and Portsmouth Herald described the storm as such. It is interesting to note the contrasting opinions between the Norfolk and Portsmouth Ledger and the letter from Mrs. Tazewell regarding the comparisons between this storm and the September gale of 1821

> .....It is uncommon to hear of violent storms and hurricanes on any part of our extensive coast in the month of June; but we have to notice a visitation of stormy weather, which commenced about 9 o'clock on Friday night (3rd), rarely if ever equaled within the life span of the oldest inhabitant. The storm of the 3rd of September 1821 was perhaps more violent but it only lasted three or four hours, while this storm continued with undiminished violence, from the hour we have stated until 12 o'clock on Saturday night (4th), or about 27 hours. The wind at the commencement of the storm was northeast and so continued until about 12 o'clock on Saturday, when it began to haul gradually to the northwest and westward, and held up at southwest....

According to this account, the tides in this storm were higher than those in the September gale of 1821.

> ....considerable damage was done by the high tide which rose at least eighteen inches higher than it was known to be within the last forty years. The highest pitch of the tide was at 12 o'clock on Saturday, at which time the stores on the wharves generally were inundated from the depth of three to five feet, and the water extended up to the doors on the north side of Wide Water Street. The whole Town Point to within a few feet of Main Street was over-flown, as also was that part of town extending eastward from Market Place to the Drawbridge, the water rising considerably above the line of Union Street. In most of the stores on the wharves, all articles liable to be damaged by the tide were found (too late for remedy) that the precaution was unavailing in consequences of the unusual rise of the tide, and the articles were of course damaged....

1827 August 24-27 (St. Kitts Hurricane): A hurricane originating near the Windward Islands struck Cape Hatteras, before moving northeast offshore Virginia, Maryland, and New England. The track of this storm was to the east of Norfolk. Initial reports from Wilmington, N.C. indicated that this was a storm of great intensity as it passed by to their east. One report gave an account of waves over the top of garden fences some 6900 feet from the beach. Other reports indicated storm tides greater than 10 feet above normal levels. The town of Washington,. North Carolina, on the western end of Pamlico Sound, reported water levels 12 to 15 feet above ordinary levels.

The following first hand account of this storm in Virginia was from the Tazewell Papers in the Virginia State Library. Henry Tazewell wrote to his brother John in New York and described the storm as such.

"....A severe gale which continued for three days changed the climate here entirely and persons are clad generally in full suits of winter clothing; the same gale has done great injury to shipping and to present crops. The fodder is worthless and the corn in many places is much broken by the wind."

The Norfolk newspapers, The American Beacon and The Norfolk Herald reported little in the way of tidal damage in this storm due to an ebb tide. There was much less damage to property in the area than in the memorable 1821 gale, but this storm was almost as violent as that gale.

Both papers reported a gale of wind which was accompanied by a copious fall of rain. The gale

"...commenced in the forenoon of August 25th and continued to increase until the evening, when it blew tremendously. About midnight, the rain ceased and the gales somewhat abated, though it continued to blow fresh all day on the 26th."

At the height of the storm, winds unroofed a two story building on Talbot street in Norfolk and commenced to blow away the second floor of the building. Livestock was swept away in large numbers. Corn was leveled at Belleview...a mill dam was torn to shreds and the bridge over it was swept away. The sloop *Flag* capsized on the Middle Ground of the Chesapeake; the vessel had no survivors. The brig *Liberty* of Boston broke away and drove itself ashore, on the south side of Portsmouth. The schooner *Mulberry* saw its bow stove in, shrouds and jib-stay carried away, and jib torn off while off Common's Marshes. A "considerable quantity" of cargo was thrown overboard to prevent it from sinking. "Considerable mischief" was caused by the tempest as far north as Baltimore.

1829 August 26-29: A tropical storm of considerable strength moved northward through eastern North Carolina and Virginia, accompanied by a tornado near Sunbury, North Carolina in Gates County. Torrential rains were reported in Norfolk. At Georgetown, the rice crop experienced great injury. Santee also saw damage. A vessel fifty miles east of Chincoteague was dismasted. The American Beacon reported the following account from this storm.

"....The earth is completely saturated and the grounds covered in water, while the roads, in many places, are rendered impassable by the rise of the water courses." (Chapman)

1830 August 16-18 (Atlantic Coast Hurricane): This hurricane passed northeast of the Caribbean Sea and tracked west north-west to a point very near Daytona Beach, Florida before recurving to the north and northeast. The center made landfall on the morning of the 16th near Cape Fear and moved back out into the Atlantic by nightfall. The area's three-month drought came to a sudden end. Complete damage was done to corn crops as a considerable amount of rain fell.

A number of ships that arrived at Alexandria on the 22nd spoke of a severe gale on the 18th...one lost its topsail. The schooner *Dove*, while thirty miles east of the Virginia Capes, experienced a severe hurricane and lost most of her upper works. On the morning of the 19th, an empty ship in full sail was seen just off the Virginia coast.

1833 August 24: As a rare act of foreshadowing, a northeast gale detained around 100 vessels at Norfolk. This system passed well off of the Virginia coast. Unlike the storm exactly a century later, no damage was reported (Chapman).

1834 September 5: A hurricane that struck the North Carolina coast also created problems for Virginia. A "severe" northwest wind capsized the schooner *E. Pluribus Unum*, laden with stones. The crew escaped with their lives. The schooners *Susan* and *George Wheaton* bumped into each other at Newport News. The *Susan*'s upper work was carried away (Chapman).

1837 August 18-20 (Calypso Hurricane): A hurricane which skirted the North Carolina Outer Banks also affected Virginia. Damage was considered lighter than at Wilmington, where bridges washed out during the storm. This was referred to as the worst storm in Norfolk since 1822. The storm was observed east of the West Indies on the 13th, moved into the central Bahamas on August 16th and began to affect the North Carolina coast on the 18th, where the Norfolk newspapers reported it had continued with unusual severity for forty-eight hours.

The *Norfolk-Herald* offers this account of the storm.

> "....One of those cracking northeasterly blows commonly called "September gales" which, however, more frequently visit our coast in August commenced here on Saturday the 19th, but as our harbor is completely sheltered "land-locked", we believe the sailors call it, none but the weather-wise had any idea that it was blowing a gale outside, until 11 o'clock at night, when the symptoms of a regular-built gale were easily recognized in the roar and rustle which it kept up, and the splashing of the torrents of rain which it drove before its streamed flows. This strife of elements continued until 12 o'clock Sunday the 20th, when the wind hauled around to the northwest but without clearing off and continued to blow a heavy gale from that point, accompanied with rain the remainder of the day."

The *American Beacon* offers this account of the storm.

> "....The weather on Saturday morning (19^{th}) indicated a gale. It commenced raining that morning and continued but with little intermission, until about 3 p.m. the next day. The wind blew fresh from the northeast all day Saturday, and at night increased to a gale, blowing down fences, trees, chimneys and prostrating the corn....In walking the streets after the storm, it was melancholy to see some of the stoutest trees prostrated. The tide is very high."

1837 October 8-9 (Racer's Storm): This hurricane was named after the British sloop-of-war, the *H.M.S. Racer*, which encountered it on September 28^{th} in the central Caribbean Sea. It was the tenth known storm of that destructive season. After moving northwest into the far western Gulf of Mexico, the storm slowly recurved along the coasts of Texas and Louisiana before it struck Venice, Louisiana on the 7^{th}.

The system then passed back out into the Gulf before making a second landfall near Pensacola late on the 7^{th}. The storm moved northeast and went off the East Coast near Wilmington late on the 9^{th}. Norfolk experienced a northeast gale on the 8^{th} and 9^{th}. This prevented steamboats from leaving their docks.

1839 August 29-30: A tropical cyclone which struck Charleston on the 28^{th} passed through eastern North Carolina on the 29^{th} and then Norfolk just past midnight that night. The hurricane raged until 3 p.m..

1841 October 3-4: An intense hurricane raced through the shipping lanes offshore the Mid-Atlantic. On the western fringe of the cyclone, several ships were beached at Cape Henry. The system went on to devastate eastern New England, when cold air encircling the increasingly nontropical storm led to "a violent storm of snow and sleet" at New Haven, Connecticut.

1846 September 8: This hurricane created Hatteras and Oregon Inlets.

1846 October 12 (Great Havana Hurricane): The Great Havana Hurricane struck the Florida Keys with great violence before moving northward, inland of the Eastern seaboard. It destroyed the Old Key West lighthouse; fourteen inside the structure perished (DeWire). The Potomac at Alexandria and Washington D.C. reached its highest heights in 20 years. Tides at Washington, D.C. rose to 6.9 feet above low water datum. Extensive damage was seen as far north as Baltimore, Philadelphia, and New York.

1850 July 18: The first of three hurricanes to affect the upper Eastern Seaboard moved into North Carolina on the 18^{th}. As it moved north, Chesapeake and Delaware Bays took a beating as high waves and tides flooded the coast. It moved almost due north into central New York state.

1850 August 24: A powerful Gulf hurricane struck Apalachicola on the 24^{th}; a great storm surge inundated the northeast Gulf coast. As the system moved north, enormous amounts of rain fell from Georgia northward to Virginia. Major flooding occurred along numerous rivers. The Dan rose to a level twenty feet above normal. The cyclone continued northeast, causing damage in its wake through New England (Barnes II).

1851 August 24-25 (Apalachicola Storm): A hurricane moved across the Greater Antilles past western Cuba on the 22^{nd}, then moved north to strike Apalachicola with a high storm surge on the 23^{rd}. Thereafter, the storm tracked through Georgia and the Carolinas, moving into northern Chesapeake Bay on the night of the 24^{th}.

High southeast gales made it the worst storm in thirty years for the region. The wheelhouse of the *Osceola* was torn away and blown overboard. Crops and small buildings were leveled. The system continued moving northeast offshore Nantucket, before making its final landfall in Nova Scotia.

1854 September 7-9: A very destructive hurricane swept the East Coast from Florida to New York. Norfolk experienced the force of the storm on the 9^{th}.

1856 August 19 (Charter Oak Storm): This weather disturbance was first noted in Virginia. Washington D.C. had east and southeast winds throughout the day, accompanied by heavy rain.

1856 September 1: This storm went through the interior of the Southeast before affecting Virginia. At Norfolk, the gale was considered an equal of the 1846 hurricane. It began at 4 a.m. and raged throughout the day. The spire of the Baptist church was blown off. A twenty year old tree met an untimely fate at Portsmouth. Much damage occurred at the Navy Yard.

1861 October 28 & November 2 (Expedition Hurricane): Occurring during the first year of the Civil War, an expedition by "the largest fleet of war ships and transports ever assembled" started at Fortress Monroe, inside the entrance of the Chesapeake Bay. As the ships were assembling, high winds and gales played havoc with their coordination, just prior to setting sail. The fleet was hit by another storm on November 2nd. Two vessels were sunk off the Carolina Capes. This second system continued northeast to Boston by late that day.

1872 October 25: A storm from the Gulf of Mexico moved across North Florida, before striking Charleston and moving up the Appalachians. Very heavy rains of four to eight inches drenched areas around Norfolk, with the 6.29" on the 24th at Norfolk setting a daily rainfall record.

1874 September 28-29: This hurricane struck southern North Carolina. It entered Virginia west of Norfolk. It was the first hurricane ever represented on a weather map (Barnes II).

1875 September 18-19 (Indianola Hurricane): The first of a series of hurricanes to end Indianola, Texas' reign as one of the leading ports in Texas, this system tracked through the Caribbean and Gulf of Mexico before striking the unlucky port on the 16th. The storm made a sharp right-hand turn through the Southeast, re-emerging into the Atlantic on the morning of the 19th in the vicinity of Chesapeake Bay.

1876 September 16-17: This hurricane moved over the Greater Antilles, and recurved just off the coast of West Palm Beach, before finally coming ashore near Cape Fear. As the system tracked through Interior Virginia, it brought a five minute sustained wind of 78 mph to Cape Henry and dumped 8.32" of rain. The 7.18" that fell on the 16th set a 24-hour rainfall record for September. High tides were seen at Washington D.C., when the level rose to 7.9 feet above low water datum. Average 5 minute wind speed at Cape Henry was 78 mph.

1877 October 3-4: A storm was first seen near St. Vincent and Grenada in the eastern Caribbean Sea...the island of Curacao was devastated. The hurricane then moved through the Caribbean Sea and the Gulf of Mexico before making landfall at Panama City Beach, Florida. It then moved north and northeast across the Carolinas, before moving out to sea near Norfolk. During the year 1877, tropical storms accounted for eleven inches of rain in the Norfolk/ Hampton Roads area.

After causing extensive flooding across North Carolina, heavy rains established floods of record. Along the James river, Lick Run (33 feet), Buchanan (34.9 feet) and Cartersville (30.4 feet) ran well above flood stage. Washington, D.C. set a 24-hour rainfall record for the month of October when 3.98" fell on the 4th. Many ships were wrecked all along the Atlantic coast, Chesapeake, and Delaware Bays. The cyclone continued northeast towards Newfoundland.

1878 September 12: As this tropical cyclone moved through the Caribbean, hundreds of lives met an untimely end. It tracked west, then northwest, moving due north from the Florida Keys to Lake Erie thereafter. Five significant tornadoes were recorded (Watson). At 1 p.m., the first tornado touched down southeast of Petersburg. The second tornado in Dinwiddie county was more destructive as it moved through Ford's Depot. Trees were leveled, while small homes and a barn were destroyed. Other tornadoes wrought havoc in Henrico county, Nottoway, and Goochland. The Goochland tornado tracked 28 miles after it descended around 4 p.m. (Watson). A great many ships were disabled and wrecked.

1878 October 23 (Gale of '78): One of the most severe hurricanes to affect eastern Virginia in the latter half of the 19th century struck on October 23, 1878. This hurricane moved rapidly northward from the Bahamas on October 22nd and struck the North Carolina coast late that same day moving at a forward speed of 40 to 50 mph. The storm continued northward passing through east central Virginia... Maryland and eastern Pennsylvania. To find out what it did to the Eastern Seaboard, check out the Gale of '78 website.

Winds began to freshen at midnight, reaching gale force at 2 a.m.. Immense waves broke over the upper deck of the steamer *Express*. Winds reached hurricane force at 4 a.m.. The ship then wandered through the middle of Chesapeake Bay. The barometric pressure fell to 28.78". The five minute sustained wind reached 84 mph at Cape Henry. At 5 a.m., waves tore away the saloon deck and flipped the ship on her side. After rolling completely over, survivors gathered timber to make a tiny escape craft. It sank immediately. The Quartermaster was rescued at noon that day, twenty miles from the scene of the wreck. The weather map above is from just after the time of the shipwreck, reconstructed from the original U.S. Signal Service data, obtained from the Library of Congress.

The steamboat *Shirley* was driven ashore Barren Island. A schooner in Chesapeake Bay was reported to have drifted into the woods. Cobb and Smith Islands were completely submerged during this storm. The *A.S. Davis* went ashore at Virginia Beach, killing 19. At least 22 ships met their demise in this hurricane.

Damage from this hurricane was widespread along the East Coast. Many of Virginia's life saving stations were damaged, with one lifted from its foundation and moved half a mile. An account of the storm's effects in the Norfolk area was provided by the Norfolk Landmark.

> "....Only strong willed people could sleep while dwellings so violently oscillated with the ravings of the tempest Tuesday night (22^{nd}). At an early hour a severe gale sprung up from the northeast and by 9 o'clock old Boreas was knocking things around town in a lively style. The rain came down in torrents and the streets at times were a driving sheet of water. Yesterday morning (23^{rd}), after the abatement of the storm it was found that considerable damage and loss was involved in the destruction of various sorts of property around the city and vicinity. The maddening fury of the elements will long be remembered as making one of the most severe storms in the annals of our city's experience...."

There is another first hand account of the storm from Mr. Bolton, an employee of the U.S. Signal Service, an early version of the National Weather Service. Mr. Bolton was a repairman of the telegraph line between Cape Henry and Kitty Hawk and was stationed at the Life Saving Station No. 3 in False Cape.

> "....I was at the station when the gale, which proved so disastrous to human to human life commenced. A severe rain storm has prevailed all day Tuesday (22^{nd}) but the gale did not reach the station until 9 p.m. It rapidly increased in velocity until it almost became a hurricane. The members of the crew at this station, whose duty it is to patrol the beach that night, performed their duties with the upmost difficulty, as they could scarcely make any headway against it, and often had to cling to some stationary object like a telephone pole to prevent themselves from being carried away at the mercy of the fearful tempest..."

Mr. Bolton described the wreckage of the ship *A.S. Davis*, which had sunk off of present day Virginia Beach.

> "....The debris was thickly scattered along the beach for a distance of fully 4 miles....I proceeded to Cape Henry, Virginia to assist the Signal Officer there. The body of one of the crew was there. About 1 ½ miles south of Cape Henry the bodies of eleven of the crew had been washed ashore.....During the heaviest part of the gale, the wind at Kitty Hawk, North Carolina registered 100 mph. The instrument itself was finally blown away and therefore no further record was made. It was the severest gale that had occurred on this coast for sometime."

1879 August 18: An extreme hurricane moved north and went on the rampage from the Bahamas to Eastport, Maine (track to the right). In the immediate Mid-Atlantic region, the track of this storm ran very close to a Wilmington - Elizabeth City, N.C. axis to just southeast of Norfolk. It was considered one of the most severe to strike coastal Virginia in the last half century and was probably as severe as the June 1825 storm.

The passage of this storm was accompanied by a rapid pressure fall from 29.58 inches at 9:00 am to 29.12 inches at 11:15 am on the 18^{th}, which was the lowest pressure observed in the storm. Five-minute sustained winds rose to 76 mph with gusts toward 100 mph at Cape Henry, before the anemometer was destroyed. The tide at Norfolk rose to 7.8 feet above mean lower low water. Dozens of ships were damaged from the Carolinas northward to Cape Cod. The rainfall from this storm was one of the heaviest in the history of Norfolk, 6.17 inches, with 6.03 inches falling on the 18^{th}...of which 5.13 inches fell in just over 9 hours. On the next page is a chronology of Observations taken at Norfolk, Virginia during the August 1879 hurricane.

The Norfolk Virginian described the "red-letter" storm in the following account.

> "....Yesterday (18th) was one of the red letter days in Norfolk's history. It was the occasion of one of the severest storms which have ever visited this section. The severity of the wind and the extent of the rains were such as have never been experienced in Virginia, and we doubt if the hurricanes of countries subject to such inflictions as visited Norfolk yesterday, have ever suffered to a greater extent from the ravings of the storm than did our city for a number of hours.....
>
> ....In the early morning the wind blew from the northeast with a strength which betokened a settled rain storm and gave everyone acquainted with our climate to understand that a bad day and heavy blow was to be expected. As the day wore on the wind became more boisterous....
>
> ....At about ten o'clock the wind had gained such strength that it was dangerous to appear on the streets, while the rain fell in such torrents that it was most disagreeable to do so.....the wind swept along with prodigious strength while the rain fell in torrents, which inundated wharves, streets and the lower floors of a number of buildings. About eleven o'clock it had reached its height, and dealt destruction on every hand. Roofs were blown off houses, trees were up-rooted, wharves destroyed and other injuries to properties inflicted....
>
> ....Water street was inundated and boast were to be seen on the water from the western terminus to Market Square. It is almost impossible to describe the appearance of the city at that time, with its frightened inhabitants running to and fro, the debris scattered along the streets and the wind playing havoc with the signs, trees, roofs, etc.

Several ships had run aground in the harbor between Norfolk and Portsmouth. The steamer *N.P. Banks* was run aground not on the flats of the Norfolk Naval Hospital (in Portsmouth) but on the very grounds of the hospital itself due to the excessive tides. The ferry boat *Berkeley* filled and sank in her dock on the Berkeley side of the river. The schooner *John C. Henry* foundered off Gwynn's Island.

The storm was described in Portsmouth as the most terrific storm to have visited the area in many years. From the Norfolk-Portsmouth Herald:

> "....As early as 3 a.m. the rain began to fall in torrents, and the wind rising about the same time, increased in violence until it reached its height between 10 o'clock and noon. To those on shore and in a safe place, if such a place can be found, it was indeed a terrifically grand sight, one not often seen in this harbor, and seen once suffices a life time. The high wind brought in the waters of old ocean, wave piled upon wave until our wharves were submerged, our streets flooded and converted to many places to temporary canals, the tide being the highest ever known. On the waterfront exposed to the full play of the wind and wave, the sight was best seen. At the northward of North Street the waves dashed against the breakwaters, throwing the spray as high as the neighboring houses, while in the harbor and river the wind striking the caps of the waves filled the atmosphere with a fine mist like spray, so that at times it was impossible to see Norfolk, Berkeley or the ships in the harbor...."

1879 October 19-22: At Cobb's Island, a steady rain began on the 19th. Offshore, high winds and seas had already led to the destruction of the *Ellie Bodine*, a schooner, 4 ½ miles south of Smith Island. North winds shifted to the southeast late on the 21st at Cobb's Island. By 9 p.m., hurricane force winds overspread the islands and "shrieked in its mad glee". Tides rose past the high water mark around midnight. Bath houses were swept away. The coast guard's house began drifting inland with the storm surge.

At 4 a.m., the New York House was destroyed. By 5 a.m., water briefly invaded the Cobb Island Hotel, then the waters began to recede. Several cottages were no longer on the island. Sand dunes rose where none stood before. It took several years before the island recovered from the hurricane (Barnes & Truitt).

1881 September 9: For the first time in 33 days, rain fell at Washington D.C.. Wires from Wilmington, North Carolina south were downed by this "tropical hurricane".

1882 September 10-11: A tropical cyclone moved across Cuba and the Gulf of Mexico before striking the Florida panhandle. It crossed Georgia, the Carolinas, and went offshore near the lower end of Chesapeake Bay. On the Washington and Western railroad, a portion of the trestle work was washed out by heavy rains. At Amherst, a landslide delayed rail traffic for 5 ½ hours. Several bridges on the Alexandria and Fredericksburg railroad were "injured" by the deluge. The gale caused mischief to shipping off the Northeast and Nova Scotia.

1882 September 21-23: This tropical storm formed near the northern Bahamas and moved north into North Carolina near Cape Lookout. Along the Lower Rappahannock, the "protracted and destructive rain storm" swept away four mills near Ware's Wharf. The brunt of the cyclone only extended fifty miles inland. Heavy rains were also seen at Washington, D.C.. It then moved into Chesapeake Bay before moving out to sea on the 23rd. Eleven inches of rain were measured at Philadelphia. Extensive flooding was reported from North Carolina northward to Massachusetts.

1883 September 12: A "protracted drought" was ended across Virginia on the 11th, as the rains from this tropical cyclone reached the Old Dominion. Unfortunately, it came too late for the peanut crop, which had already failed. A train wreck which occurred on the Norfolk and Western railroad near Nottoway Court House Station may be attributed to this cyclone. Ten freight cars were derailed. The schooner *E.C. Knight Jr.* wrecked near Cape Henry.

1885 August 25: Floods accompanied this storm as it passed by the area. Copious rains fell in Baltimore, dropping the temperature 24 degrees in two hours. Flooding rains were seen across Maryland. In Maryland, lightning set fire to a residence in Ellicott City ($16,000 damage). On the steamer *Arrowsmith,* just offshore Cedar Point, high seas and a strong gale burst the bulkhead of the wheelhouse. For twenty minutes, the crew worked feverishly to fix the ship, which made it to Washington, D.C. only an hour late.

1885 October 12: A tropical system moved from southwest of Florida northward into the panhandle, reaching southwestern Virginia around midnight on the 12th. A large sea lion escaped its pen during the cyclone, and was last seen swimming down the Chesapeake.

1886 June 22: At Lynchburg, a "terrific rain" led to street flooding, setting a new record for the wettest June at the site (5.44"). In Washington, D.C., 4.16" of rain fell on the 22nd alone, setting a 24-hour rainfall record for June.

July 1-2, 1886: Two days of heavy rain led to flooding in southeast Virginia. The James at Richmond was ten feet above the high water mark, submerging all wharves, and leading to evacuations. Several trestles on the Richmond and Allegheny railroad were washed away, hampering travel. Washouts on the Richmond and Danville railroad led to a further stoppage in travel.

1886 August 24: This hurricane was first noted in the eastern Caribbean Sea in the middle of August. It tracked westward, before turning on a more northwest rack southeast of Jamaica. The beginning of a destructive week, it was followed by the strong Charleston Earthquake on the 31st (Vojtech).

1887 August 21: The British steamer *Propitious* encountered the storm sixty miles below Cape Henry. The captain of the vessel was swept overboard as heavy seas crashed over the decks. It was the worst weather system the ship had encountered in sixteen years.

1887 October 31-November 1: On the 29th, this storm moved northeast from Florida some distance off the Atlantic coast. Heavy gales were seen along the coasts of North Carolina and Virginia. The "furious northeasterly gale" caused telegraph lines to go down between Norfolk and Cape Henry. Winds were sustained at 78 mph for five minutes at Cape Henry.

A record number of maritime mishaps were caused by the storm. Four ships, the *Mary D. Cranmer, Carrie Holmes, Manantico,* and *Harriet Thomas* were lost. Two lives were claimed offshore (Pouliot). The *Carrie Holmes* was driven so high into the beach that its crew jumped off the schooner and waded safely to shore; it proved a $7000 loss.

1888 August 21-22: This hurricane initially devastated southeast Louisiana before recurving northeast through the Ohio Valley. At Wheeling, West Virginia, heavy rains led to a two to six foot submersion of area roads. Bridges were washed out. A piece of the Baltimore and Ohio wooden bridge from Pittsburg collided with one of their other bridges at Main and 16th streets, leading to its second destruction in six weeks. A quarter million in damages were reported.

In Petersburg, a "terrific wind storm" blew through town, uprooting trees. At Carter's Wharf, lightning struck during a baptism ceremony, killing three and stunning all that were present. The storm was severe around southern Chesapeake Bay, demolishing numerous wood-frame houses, barns, and two schooners. An immense waterspout swept out of Chesapeake Bay onto Poole's Island.

Heavy showers and high winds were experienced in Washington, D.C.. Winds were sustained between 40 and 50 mph, with gusts above sixty. These gales led to the destruction of the tower of the Church of the Covenant around 4:40 a.m. on the 22nd ($30,000 in damage). . At least two tornadoes were spawned in Delaware. Another tornado moved from Springfield across Glendale and Bowie, destroying homes, trees, and a chapel along the way. Nine perished in Maryland. Floods inundated Ohio, West Virginia, Pennsylvania, Maryland, Delaware, and Massachusetts.

1888 September 10: A tropical storm moved through the Bahamas on the morning of the 7th, before moving across the Sunshine State. The cyclone re then curved northeast around the Bermuda High, reaching Virginia by the afternoon of the 10th (track to the right). Four months of drought abruptly ended at Southside. Heavy rains completely submerged corn and tobacco crops. The Appomatox flooded wharves; the river reached its highest level since 1877. It was considered a "terrific gale" at Onacock. The British schooner Elk was driven ashore and stranded at Parramore Beach. All aboard were rescued.

1888 October 11: A hurricane moved northeastward from the Eastern Gulf of Mexico through North Carolina and crossed just west of Norfolk.

1888 November 25: A tropical system which moved about 150 miles off of Cape Hatteras produced high winds along the Mid Atlantic coast as it was becoming extratropical. Cape Henry saw sustained winds reach 72 mph for five minutes. Norfolk experienced winds howling at 50 mph for five minutes which knocked down telegraph lines and high tides flooded lower parts of the city; their pressure fell to 29.50".

Vessels were blown from their moorings. The sloop *Lizzie Jane* wrecked 1/4 mile north of Cobb Island. Cold air rapidly enveloped the storm, as the surfman at the False Cape Life-Saving Station reported blinding snow (Pouliot). Fortress Monroe, Winchester, and Richmond also went through a snow storm. Flurries in Washington, D.C. were accompanied by blustery north winds. Wires in the District were downed, and a telegraph pole broke off 25 feet from its base.

1889 April 6-7: Although this cyclone was not likely to have been a true hurricane, it showed all the telltale signs to those in Virginia Beach at the time. Winds were blowing at a "hurricane rate" from the north-northwest. Gusts exceeded 100 mph at the Signal Service station in Cape Henry. Trees were uprooted and sand dunes quickly transformed into quicksand during the heavy rain. The Cape Charles lighthouse saw its south end protection wall undermined as it was pounded by high waves. High tides totally surrounded the station (Vojtech).

Lower portions of Norfolk flooded as tides rose to 8.4 feet. A fire on Water Street raged out of control, consuming the entire block. Roofs of the Opera House, Masonic Temple, and many dwellings were blown away. The Virginia Beach railroad depot saw damage, as well as hundreds of yards of its track. A fire at Portsmouth destroyed a lime and lumber yard. The U.S. vessel *Pensacola* sank while in dry dock. High tides flooded its dock, and as the ship filled with salt water, its keel sank.

Richmond experienced its worst storm of the winter and spring. Heavy winds, rain, sleet, and snow pelted the state capital. Charlottesville's snow storm led to downed wires and delayed rail traffic. Petersburg experienced a horrible blizzard, as trees were uprooted, and houses "rocked" with the wind. Winchester measured fourteen inches of snowfall while at its height, with thunder startling their citizens. Telegraph wires were strewn across the countryside.

In Washington, D.C., rain turned to snow by 8:30 a.m. on the 7th. By 10:30, lightning and thunder were observed, leaving residents in awe. The Weather Bureau could not explain the occurrence of snow and thunder, but mentioned in would be known within a "few years". The blizzard caused thousands of dollars in damage, as telegraph and telephone lines were downed in great numbers. The White House had its communications cut off by the storm between 1 and 2 p.m., as the weight of the wet snow downed area lines. A tornado actually touched down amidst the chaos along the waterfront, as five telegraph poles were snapped at the base.

Three schooners stranded on Virginia Beach near the Seatack Life-Saving Station. The four- masted vessel *Benjamin F. Poole* was left high and dry on the beach after the severe cyclone. Blowing rain and sand almost blinded the surf men trying to rescue the *Emma F. Hart*. At 7 a.m. on the 7th, the Cobb Island Life-Saving Station keeper observed the sloop *J.O. Fitzgerald* race towards Bone Island, running aground 3/4 of a mile away. All offshore survived the tempest.

1889 September 9-12: This hurricane moved from Puerto Rico on the 5th to just offshore the Virginia capes on the 10th before stalling. The steamer *El Mar*, on its maiden voyage, encountered the hurricane on the night of the 9th just north of Cape Hatteras. The vessel fought seas higher than 45 feet and strong winds for the next couple days.

Destructive gales and unusually high tides were felt from Virginia northward to New York. Winds increased to 30 mph at Cape Henry on the 11th, temporarily knocking down telegraph lines to Norfolk. By the 12th, the lower coast experienced 40 mph winds. Along the Eastern Shore, bridges were swept away, telegraph lines were downed, lowlands inundated, and crops ruined. The wind "blew a hurricane" at Onacock, with high tides completely submerging its wharves.

Vessels at Hampton Roads dragged anchor. A brigantine-rigged steamer went ashore Cape Henry at 7 p.m.. The British steamship *Godrevy* grounded 3/4 of a mile northeast of the Cape Henry Life-Saving Station, just before 8 p.m. on the 12th, which proved a $11,900 loss. The crew of 23 were saved. Winds and seas moderated by midnight.

1889 September 24: President Harrison was visiting Elkins, West Virginia at the time, and noted that it rained considerably.

1891 October 10-12: A system born in the Western Caribbean moved northward to just off the North Carolina coast. The U.S.S. *Despatch* , the President's ship, foundered 2 ½ miles north of Assateague Beach on its way to pick up the Commander-in-Chief. The sailing ship *Challenge* fell victim ½ mile southwest of Wachapreague (Pouliot).

1893 June 15-16: A hurricane hit Cedar Key, Florida and moved northward across coastal sections of the Carolinas before moving out to sea near Norfolk. Birdnest, in Northampton County, recorded 4.8" of rain on the 16th.

1893 August 28 (Sea Islands Hurricane): A hurricane passed just east of Cape Hatteras. Five minute sustained winds rose to 88 mph at Cape Henry. Cape Henry (3.97"), Hampton (3.92"), Langley Field (3.92"), and Norfolk (5.97") set 24 hour rainfall records for the month of August in this storm. Petersburg experienced a "perfect gale" between 4 and 5 p.m.. Trees and fences were leveled. Area orchards were greatly damaged. Corn, fodder, and tobacco were seriously injured. At Harper's Ferry, a damaging wind and rainstorm began at 7 p.m.. The District Militia's camp was demolished. A large number of trees were uprooted.

Alexandria plunged into darkness at 9 p.m., as power was cut off by the cyclone. Trees fell in by the score. Considerable damage was does to trees and the corn crop in Alexandria and Loudon counties. Small craft at the wharves sank. The river overflowed wharves, at the water from the river extended into Union Street. At the waterfront, the steamer *W.W. Colt* was badly damaged. The hull of the schooner *Franconia* was in serious disrepair. Fifty tons of coal were claimed by floods at Anacostia. A washout occurred at Cherry Hill Station, along the Washington and Southern railroad, rerouting train traffic.

In Washington, D.C., telegraph and telephone lines were "laid prostrate" on the night of the 28th as five-minute sustained winds reached 42 mph. For the first time in weeks, a good rain fell across the area. By 10 p.m., a smokestack was blown off a locomotive. The Pension Bureau roof was torn away by the high winds. Windows were shattered throughout the Federal City. Tides at Washington, D.C. peaked at 6.5 feet above low water datum. One man near Raleigh Springs, in northern Virginia, perished while trying to ford a stream.

1893 October 4 (Chenier Caminanda Hurricane): In Louisiana, 2000 lives were lost when the hurricane crashed into the region around Grand Isle (track to the left). As the system was exiting the Mid-Atlantic coast, the schooner *Colter C. Davidson* sank south of Cape Henry. Two three-masted schooners were stranded on the beach near the Seatack Life-Saving Station. The northeast gale battered the schooners *W.M. Applegarth* and *C.C. Davidson* that evening.

In Washington, D.C., a "perfect deluge" led to the flooding of the Patent Office. All the examiners, clerks, messengers, and laborers began to rescue valuable records and property from the rising waters. Many cellars along the south side of Pennsylvania Avenue from Third to Thirteenth Street were flooded. The depot of the Baltimore and Potomac railroad looked like a "light-house, standing as it did in the centre of an immense lake" near the intersection of B and Sixth Street.

1893 October 13-14: While the previous system was moving across North Carolina, another hurricane lurked east of the Leeward Islands. This hurricane of large size tracked east of Florida to the Carolinas. High winds and tides were seen from Florida northward to New England (Barnes II).

At Richmond, winds became a "perfect gale" as rain fell in torrents. Homes were partially unroofed, and trees fell in the capital squares. Between Richmond and Danville, a passenger train struck a fallen tree while a freight train struck another tree. Many lines fell across Petersburg. Dwellings in town rocked to the wind gusts. Barns and outhouses were razed to the ground. Roanoke watched as their river rose to levels unseen since 1853. Washouts occurred along the Norfolk & Western railroad, delaying traffic from twelve to fourteen hours. The town of Elliston was submerged by the Roanoke river, sweeping away houses. During this storm, 2.98" of rain fell at Stone Gap, setting a 24 hour rainfall record for the month of October.

Alexandria saw its wharves crumble before the high waters ($25,000). The James river eclipsed the level attained during the Johnstown Flood of 1889 by twelve inches. A fire in Baltimore burned down its electric light plant, giving the city more of the look of a "country town." Hyattsville saw a terrific gale by 5 p.m., putting its windmills briefly out of commission. Bladensburg saw winds level fences and partially unroof homes.

In Washington, D.C., the Calvary Baptist church's side wall blew down ($3000). Associate justice of the Supreme Court Henry B. Brown was seriously injured when a plate glass window shattered at his new home at the northwest corner of 16th street and Riggs at 7:30 p.m.. Trees and their limbs were strewn throughout the city. Rainfall began in the morning and increased throughout the afternoon. Sewers were flooded by this downpour. By 6 p.m., gale force winds swept through the Federal City. Damage to police and fire wires was "greater than ever before been experienced." Waters on the Potomac rose six feet above the high tide, which was three feet below the high water mark. The Anacostia bridge became submerged.

Mariners experienced the wrath of this hurricane as well. The schooner *Edward Ewing* sank at Store Point, south of the Piankatank river. In the District of Columbia, the steam launch *Katherine Holbrook* sank. The *Nellie Marr* saw its bottom smashed by the high seas. The freight vessel *Mount Vernon* sank at her wharf. The *W.W. Colt* went on a rampage, injuring two other vessels before crashing against the ferry slip, smashing her port side.

1894 September 29: This hurricane passed just west of Hatteras. Winds sustained for five minutes at Cape Henry peaked at 80 mph with gusts to 90 mph. Vessels were wrecked along the coast from North Carolina northward to New England.

1894 October 9: A hurricane which formed just offshore Panama and Colombia moved north to hit Apalachicola, Florida and moved across coastal sections of the Carolinas before heading out to sea near Norfolk, restriking the coast at New England. The storm was severe in the Chesapeake Bay. The steamer *Eastern Shore* was nearly buried by high seas. The *Henry Lippet* was severely damaged after a collision 3/4 of a mile below Fort Monroe. A steam barge ran aground near Baltimore Harbor.

At Newport News, a terrific rain and wind storm raged. Northeast winds reached up to 60 mph. Many maritime disasters were witnessed. Among the wrecks were the schooners *Lorena Reen, John H. Cross,* and the bark *Ogin.*

1896 July 8-9: This hurricane struck the Florida panhandle just east of Pensacola on the morning of the 7th. The decaying tropical storm moved north into the Ohio Valley. On the favorable eastern side of the system, tornadoes touched down across North Carolina and Virginia, leading to isolated pockets of destruction. A tornado swept through Dinwiddie and Prince Georges counties. Dwellings were leveled, along with trees and outhouses. Buildings were lifted up and moved fifty yards. Six perished.

Torrents of rain along the Atlantic & Danville railroad led to the Dan river overflowing its banks, flooding thousands of acres of low lands. Several bridges were swept away. Damage to crops, particularly corn, occurred with the flooding. Many cattle were drowned in swamps around Norfolk.

1896 September 28-October 2: A hurricane developed in the breeding grounds of the tropical Atlantic before moving through the Caribbean Sea and the Gulf of Mexico. The system then tracked inland through the Southeast to the west of Washington D.C..

Richmond suffered severely from the cyclone. Communication was gone early on during the storm... the only line that remained open belonged to Western Union, the wire than ran to Wilmington, N.C.. A "perfect wilderness" of uprooted trees and downed limbs lay everywhere. The steeple of the Second Baptist church yielded to the storm, falling across main street. The Governor's Mansion survived the cyclone reasonably well. Damage totaled $150,000 at the state capital.

Petersburg witnessed a "perfect hurricane" between 7:30 and 10:30 p.m.. The Imperial Hotel was unroofed. Smaller buildings experienced great damage. The Western Union office took fire, but the blaze was quickly extinguished. All lines were downed. "Needed rains" fell at Leesburg, but high winds at that locale led to high timber losses. Fredericksburg saw its St. George's church steeple injured by the cyclone.

In Alexandria, damage was widespread. The Third Baptist Colored church was razed to the ground ($5000). Over forty windmills were wrecked at Falls Church. Travel was virtually impossible due to the volume of downed trees which blocked the roadways. Hyattsville and Bladensburg experienced injury, as windmills fell, and numerous windows and skylights were shattered. Wood-frame buildings were blown from their foundations. Manassas saw its Evangelical Lutheran church blown six inches off its foundation.

At the nation's capital, a rapidly moving deck of low clouds streamed in from the Atlantic on the heels of brisk southeast winds. After the wind shifted to southwest, thunderstorms caused continuous lightning to light up the night sky. It was one of the worst storms on record in the District of Columbia as five-minute sustained winds peaked at 66 mph and gusts reached 80 mph; the pressures fell to 29.14" around 11 p.m.. At 10:30 p.m., the steeple to the New York Avenue Presbyterian Church crashed to the ground. A five story brick building was demolished, injuring the adjoining buildings, trapping five men under debris. The tower of the Grand Opera House was "hurled to the sidewalk."

Uprooted trees blockaded several streets in the District. A horse perished after stepping on a live wire. Many buildings were unroofed. The Metropolitan Railroad Power House in South Washington caved in, causing all buildings within one-half block to shake; its crash was audible a mile away. Capitol Hill saw even greater damage. Georgetown experienced its worst storm ever. The Baseball Park saw $500 in damage. A few panes of glass at the White House were shattered as well. Winds began to subside by 12:55 a.m.. In all, a $390,000 in damage was incurred.

Heavy rains fell as well...see the chart to the left for 24-hour rainfall records set for September during this cyclone. A flash flood at Staunton, along Lewis Creek, overran its banks, killing five. Seven inches of rain on the 30th swelled a large lake near the town, bursting its dam at 10 p.m.. Alarms were sounded as torrents of water rushed down Central Avenue, submerging everything in its path. As it invaded the Water Works and electric plant, fires in their furnaces were quickly extinguished, plunging the city into darkness. The gas works was swept away by the raging flood. Twenty-five houses were moved from their foundations before crumbling in the angry waters ($500,000). Great washouts occurred along the Norfolk & Western railroad from Roanoke to Hagerstown. Streets in Roanoke became rivers. On the 1st, the Potomac and Chesapeake & Ohio Canal merged into one as flood waters increased their height and breadth. At Buena Vista, the fire department wall called in to save those in peril from their floods.

Tides rose to 7.0 feet above low water datum at Washington, D.C.. The scene at the waterfront was "one of indescribable confusion." Power was out, and mud had invaded surrounding land areas. Most everything, including vessels in and around the wharf was destroyed. The steamer *George Leary* ran amok when her wharf succumbed to the storm. Careening with the current, she crashed against the *Sylvester*, when then took part in the joyride. They crashed into four other vessels before coming to rest against the Norfolk steamer *Washington.* From Cedar Point to Sandy Point, fourteen vessels went ashore. The schooner *Capital* foundered at anchor, taking the lives of here crew (three in all).

Cobb's Island was submerged. Its hotel was demolished, along with any remaining cottages and private dwellings that weren't destroyed during the powerful nor'easter of 1895. This storm led to the abandoning of the island by Fall of 1897 (Barnes & Truitt). Damaging winds spread northward through northern Virginia, Maryland, and Pennsylvania. Its gale force winds extended from New York to Chicago. Sixteen perished across the region: three in D.C., seven in Virginia, and six in Maryland. Total losses exceeded $1.5 million in Virginia and the District of Columbia.

1896 October 11-13: Serious damage occurred at Virginia Beach, amounting to several thousand dollars from this cyclone. Winds of 40 mph blew through Norfolk while 70 mph lashed the Capes. The Cape Henry lighthouse keeper's residence was submerged by the system's storm surge. High tides reached the life-saving station. Water was blown up to the boardwalk of the Princess Anne hotel. All telegraph wires and poles were carried away by the tide. Around Norfolk, the Dismal Swamp canal was badly flooded; its banks "honey-combed and caving in many places." Two perished.

A northeast wind arose at Cobb's Island on the morning of the 5th and increased as the day wore on. It became a gale, then a hurricane, which moved the islanders into action. All furniture was moved into the upper floors of structures to escape the rising waters. Soon the island was completely submerged. As people watched from their second stories, stock and cattle were swimming around their homes, expressing their distress. Among the animals in the surging waters were horses, cows, goats, and dogs. The highest points went underwater before the lifeguard went from house to house, saving people's lives.

The Baltimore cottage was a total wreck, battered by the waves. Several cottages were found half buried in the sand. The island shrunk to a size of only fifty acres after this storm (Barnes & Truitt). At False Cape, eight fishermen took refuge at the life-saving station. Two women on Cobb Island were rescued by surfmen, as heavy swells were sweeping them out to sea. It was two days before the weather improved, and the coastal flooding receded (Pouliot). The bark *Henry A. Litchfield*, with a cargo of lumber, went ashore Pleasure House Beach between 4 and 5 a.m. on the 12th, twenty four days out of Brunswick, Georgia. It braved the previous storm at the end of September, before succumbing to this cyclone.

1897 October 20: A rapidly moving storm of tropical origin passed northeastward off Cape Hatteras. Maximum winds of 60 mph blew through Cape Henry.

1897 October 24-26: On the 24th, this misbehaved tropical cyclone went from a northeast course to a more dangerous northwest course towards the Mid Atlantic region. It completed a small loop off the Virginia capes before heading westward into extreme northern North Carolina. A number of small craft had already washed ashore on the 24th. At Cape Henry, winds reached 64 mph on the 24th. Low streets of Norfolk were flooded. Two fatalities occurred when one person came in contact with a live wire and another was on the telephone. On the 25th, the James river rose to five feet above high tide. The catboat *Louise* was blown ashore Newport News, proving a total loss. Winds at Cape Henry rose to 70 mph. Increasing tides cut a break through Willoughby Spit, washing away the Old Point Comfort railroad tracks.

Trees were leveled at Hampton. Cobb's Island went totally underwater, forcing the crew of the life-saving station to abandon the isle. The 26th brought continued northeast gales to the coast. A Norwegian sailing ship was being destroyed while in tow fifty miles southeast of Cape Henry, and was abandoned. All aboard survived. Four fatalities were reported at Newport News. In all, this storm lasted for 60 hours and produced tides of 8.1 feet above mean lower low water. Winds and high water inundated the business section of Chincoteague. The hotel on Metompkin Beach was wrecked. Cedar Island was "leveled to a mere flat breath of sand" (Barnes & Truitt). The schooner *L.A. Rose* went down one mile southeast of Assateague Beach while the steamer *Polaria* wrecked one mile northwest of Cape Henry.

1899 August 17-18 (San Ciriaco Hurricane): The damage produced by this storm in North Carolina is considered unparalleled. It left its mark in Virginia as well. On the 16th, wind at Cape Henry reached 52 mph. By the 17th, Cape Henry saw winds peak at 68 mph for five minutes, and gales expanded westward past Norfolk...low lying areas were inundated. Norfolk's pressure fell to 29.62" as five-minute sustained winds reached 42 mph.

The storm was quite severe along the James,. At Suffolk, livestock drowned in the flood waters. At Petersburg, a "heavy northeastern storm" began the night of the 17th. Corn and tobacco experienced considerable damage as crops were leveled by the wind.

1899 October 30-31: This storm took a similar path to Hazel. It was becoming a nontropical low while passing through North Carolina, but that didn't weaken the system at all. Cape Henry saw winds of 74 mph over a five minute period. Norfolk tides reached 8.9 feet above mean lower low water. Norfolk experienced 50 mph winds level trees and signs...windows in the area shattered. Brighton experienced the leveling of several homes. Tides again created a break in Willoughby Spit, damaging railroad tracks. In Danville, the gale reached its height between 7 and 8 p.m. on the 30th, unroofing several houses and damaging shade and fruit trees. Winds died down by noon on the 31st.

The Cape Charles lightship was under significant strain; the starboard chain broke and carried away all the castings and connections. The three-masted schooner *Kate Darlington* wrecked on Ocean View Beach at 1 p.m. on the 30th, after being struck by a steamer on the Virginia Capes. The schooner *W.S. Rowley* beached at Nix's Wharf in Suffolk...two wharfs there were badly damaged. The 1000-ton, four-masted schooner *Bayard Barnes,* after springing a leak, became stranded on Willoughby Spit. Damage from the cyclone spread northward into Ontario and Newfoundland, in Canada.

TWENTIETH CENTURY

1900 October 13-14: The six-masted schooner *Wells,* proclaimed as "the only of her kind in the world" sought shelter from the gale in Norfolk, with a 5000 ton cargo of coal.

1901 July 10-11: On the 10th, northerly gales commenced from Cape Hatteras to Henry. Winds averaged 50 mph at Cape Henry that night, which downed lines. A severe thunderstorm in Richmond, on the western fringe of this storm, claimed a victim when lightning struck a tree in her yard. In Berryville, heavy rains and winds did great damage to crops as it leveled trees and stripped off fruit during the cyclone. A barn was struck by lightning, instantly setting it ablaze ($2000). Artillery practice in the Chesapeake Bay was interrupted as high winds wrecked floating targets.

1901 September 16-18: A "terrific northeaster" prevailed along the coast. Four men off Ocean View drowned after setting sail during the storm. Newport News reported 3.32" of rain, which set a 24-hour rainfall record for the month of September. The schooner *Joseph J. Pharo* went down 1 ½ miles south southeast of Assateague Beach on the 16th. By the 17th, the schooner *Edith G. Folwell* wrecked one mile north of Cape Henry. The sloop *Dude* capsized off Sewells Point. Those aboard clung to the wreck and were rescued and taken to Cape Charles. The schooner *Idle Times,* while in Chesapeake Bay, was "run down" by a Pennsylvania railroad barge that was in tow, killing the schooner's captain.

In Maryland, Braddock experienced significant damage leaving few homes, barns, or outbuildings untouched. Poplar Terrace was damaged as a water tank was swept off the house. Nearly 300 window panes were destroyed by the wind there. Two horses perished. Montevue hospital's roof was partially torn off as 1500 windows were demolished. At Liberty, twelve barns overturned. Growing corn was in ruin.

1902 June 14-16: On the 14th, the steamer *Falcon* fell victim to the storm two miles southeast of False Cape. Twenty-four hour rainfall records were set for the month of June during this cyclone at New Canton (3.70") and Fredericksburg (3.45") on the 16th. The deluge broke a drought, benefiting tobacco crops most.

1903 September 15-17: This deadly hurricane struck the New Jersey shore. It was considered the worst storm in forty years at Ocean City, MD. Salisbury saw several schooners break from their moorings, smashing themselves downstream. President Theodore Roosevelt experienced the hurricane firsthand while aboard the naval yacht *Sylph*, as winds increased to 65 mph in Long Island sound. Other than a drenching, all aboard fared well. At the Delaware Capes, 80-mph winds lashed the schooner *Hattie A. Marsh,* dashing the vessel upon the rocky shore; five perished. The torpedo boat destroyer *Lawrence* took on a foot of water while fighting the storm from Atlantic City to Norfolk.

In Virginia, a strange scene unfolded. As the cyclone passed northeast of Old Point Comfort, a shower of dead birds, most feathers plucked off by the wind, fell from the sky. Hundreds of birds, about the size of a wren, were downed around Old Point Comfort. The foremast of a schooner was claimed by a squall near Cape Henry around 3:30 a.m. the 17th. A few small craft were thrown ashore. The fishing schooner *Beatrice* disappeared into the cyclone several miles north of Chincoteague with a crew of 30 ($25,000). In the District of Columbia, heavy rains washed out a baseball game between the Washington Senators and the Detroit Tigers. Strong west winds accompanied the deluge as it flooded the field.

1903 October 8-10: Cape Henry saw winds over five minutes average 74 mph with a tropical system that became nontropical off the Outer Banks of North Carolina. Norfolk's tide rose to 9 feet above mean lower low water. In Norfolk, a tree brought from the grave of Napoleon Bonaparte to the city was uprooted; it was one of most historic features of the city at the time. Plate glass windows shattered in the wind. Communication was wiped out as wind knocked down wired and cables. It was the worst storm in 15 years, as rain and wind plagued the city for over 48 hours.

At Richmond, a "furious wind storm" descended upon the city the morning of the 9th, accompanied by a 20 degree fall in temperature. Trees were uprooted and communications were "disturbed" in the state capital. An elderly man in Leesburg drowned while trying to cross over Little River on a log.

The coast of the Old Dominion was strewn with wreckage from Cape Henry to Dam Neck Mills on the 10th. Fourteen foot high waves battered the Back River lighthouse; stones from the light were moved out of place. It took 72 hours of continuous work to save the light, its house, and the walkway (Vojtech). The cruiser *Olympia*, in dry dock at Norfolk, saw the tide reach just six inches from the top of the outer edge of its caisson. Terminal piers of the Norfolk & Western and the Southern & Atlantic Coast lines were badly damaged. The Ocean View pleasure pier was wrecked.

At the nation's capital, the grain mill and elevator of S.S. Dalsh & Co., located on Florida Avenue, burst into flame during the storm at 11 a.m. on the 10th, leading to a $90,000 loss. Another fire at a stable along Jackson Street Northeast was entirely destroyed, its two horses perished ($400). A fierce gale blew throughout the 9th during the Columbia Golf tournament. It took more than two hours to go through the rounds.

Two men drowning off Virginia Beach were rescued by a member of the Cape Henry Life-Saving Station, earning him a Gold Life-Saving Medal (Pouliot). The Assateague Beach life savers rescued eight fishermen when their home was swept away by high waters. The Wachapreague Life Station was abandoned when it was becoming submerged by the storm surge. High water threatened other dwellings at False Cape.

In the Lower Chesapeake, two three-masted schooners were blown ashore on the 9th. The tug *Richmond* was battling a northeast gale by late on the evening of the 8th. The schooner barge *Georgia* parted cables and drifted ashore near the Virginia Beach Life-Saving Station. Hurricane-force winds took their toll on the schooner barge *Ocean Belle*, before its cables broke at 10:30 a.m. on the 10th. The schooner landed broadside on the beach before immediately breaking up in the dangerous waves. Two perished. The *Nellie W. Howlett* sank three miles south of the Dam Neck Mills Station. In all, nine ships had mishaps offshore the Old Dominion. Three perished. As the cyclone moved north, rains amounting to ten inches drowned New York City. Damage was experienced up the coast to Block Island.

1904 September 14-15: This storm made landfall in eastern South Carolina before moving north and northeast to pass offshore as a nontropical low near Norfolk. Ashland recorded 3.88" of rain on the 14th.

1904 November 13: This hurricane moved north to near Cape Hatteras. As the system became nontropical, cold air on the west side of the circulation set up an early snowstorm across North Carolina. A twenty-four hour rainfall record was set for November at Farmville (3.17"). The schooner *Robert J. Poulson* went down one-half mile southwest of Hog Island on the 13th.

1913 September 3: Danville set a new 24-hour rainfall record for September (3.59").

1920 September 30-October 1: The schooner *Thomas F. Pollard* foundered off Cape Henry.

1924 August 26: This hurricane passed just east of Cape Hatteras. Maximum sustained winds reached 72 mph at Cape Henry.

1924 September 29-30: Norfolk saw winds reach 76 mph sustained from a cyclone that became nontropical over the Southeast U.S.. In Fauquier county, four inches of rain fell at Leads Manor on the 29th. In Richmond county, 4.6" of rain fell at Warsaw on the 30th. Leeds Manor (4.00"), Stuart (4.20"), Urbanna (3.80"), and Winchester (2.05") all set 24-hour rainfall records for September during this tempest. The moderate flood along the C & O canal created by the cyclone led to an end of boating operations (High).

1925 December 2: A rare hurricane formed in the Caribbean Sea and moved north northeast across South Florida and moved into the East coast between Wilmington and Cape Hatteras at 6 p.m.. The storm center passed out to sea near Cape Henry. Langley Field reported 3.36" of rain on the 2nd. Other 24-hour rainfall records for December were set during this storm at Callaville (2.24"), Onley (2.30"), Runnymede (2.51"), and Warsaw (3.10").

1928 August 11-12: A category two hurricane moved northwest across Florida on the 7th and 8th, weakening as it wandered northwest into Georgia. The decaying system dumped more than six inches of rain across the Carolinas and Virginia as it moved northeast, sending river levels well beyond flood stage (Barnes II). Norfolk recorded 39 mph sustained winds on the 12th. Heavy rains fell at the Sewer Department in Washington, D.C. when 7.31" deluged the area. The brig *Walton* foundered off Sandy Point, Maryland during the storm.

1928 September 19 (San Felipe/Lake Okeechobee Hurricane): This tropical cyclone was experienced by the *S.S. Commack* near 17N 48W, and send a radio report about their weather conditions. This was the most easterly radio report concerning a tropical storm in the Atlantic at the time (Barnes II).

Epic destruction and loss of life from this vicious storm spread across Puerto Rico and Florida before it tracked into North Carolina. This storm caused tremendous flooding in North Carolina. Maximum sustained winds were 72 mph at Cape Henry. Tides peaked at 7.2 feet above mean lower low water at Norfolk. Heavy rains were seen at Langley Field on the 18th (3.88") and Onley on the 19th (5.22").

1933 August 21-24 (Chesapeake-Potomac Hurricane): On the 17th, a tropical storm was discovered about 100 miles east of Puerto Rico. This system quickly strengthened into a hurricane by the 18th, as it tracked northwest (track to the right). As the cyclone neared Bermuda, a blocking high pressure ridge over New England changed the storm's course to more westerly. The British colony of Bermuda was lashed by 80 mph winds as the center passed 100 miles to the southwest of the island. \

Rough surf conditions developed near Hampton Roads during the afternoon of the 22nd. The system made landfall near Nags Head around 3 a.m. on the 23rd. By 9 am, the center passed over Norfolk, where the pressure fell to 28.68". Some of the lowest pressures ever measured in Virginia occurred with this hurricane. The lowest pressure of 28.68" occurred at 9:20 a.m..

This was the first time an eye of a hurricane had passed over Norfolk since the great hurricane of September 3, 1821. Sustained gales extended well inland over northern sections of Virginia. Maximum winds were 58 mph at Washington D.C., 70 mph at Norfolk, 82 mph at Cape Henry, and 88 mph at Norfolk Naval Air Station. Areas near the Chesapeake saw over 10 inches of rain (rainfall map below). Some areas measured eight inches of rain in one day. Washington D.C. experienced a 6.39" deluge.

This storm produced a record tide of 9.8 feet above mean lower low water at Sewells Point. Norfolk saw a tide of 9 feet above mean lower low water. Five feet of water flooded the city, damaging area crops.

A six to nine foot storm surge passed up the Chesapeake Bay. A combination of the storm's surge and back water flooding along the Potomac caused crests as high as 12 feet above mean lower low water on the river. Colonial Beach stood by helpless as four feet of water flooded the town and swept the town's amusement park away. Water also flowed into some hotels bordering the Potomac River.

Severe flooding occurred at Alexandria and Washington D.C.. In Washington, D.C., numerous trees were uprooted and many houses unroofed. The Potomac at Alexandria reached its highest stage since the Johnstown Flood of 1889. In Alexandria, high winds played havoc with phone and power lines. High water in Four Mile Run cut off Alexandria from the Federal City. Two men were nearly doomed when the Cameron Run bridge on Telegraph Road was washed out. Farms in Fairfax county suffered heavy damage; fields were flooded, ruining crops. All aviation activities out of Quantico were suspended. High winds and rains flattened corn crops and damaged peach orchards in Loudon county. St. Mary's county saw damage to corn and tobacco. In the Richmond area, damage was confined mainly to broken windows and downed tree limbs. In Anne Arundel county, 44 mph winds took a heavy toll on crops, leading to $250,000 in damages alone.

Some high water marks in Alexandria included 2 feet at the Ford Motor Company Plant and 5 feet at the Old Dominion Boat Club. Flood waters completely inundated the lower end of King Street in the Old Town section of Alexandria. The Washington-Richmond highway (U.S. Route 1) was inundated to a depth of 8 feet in a few sections below Alexandria at the height of the storm. Mount Vernon Boulevard was under 5 feet of water. Flooding in the Anacostia river rose over the seawall.

The Washington Hoover airport was inundated to a depth of three feet at the height of the storm. The Benning Bridge was under two and a half feet of water blocking vehicular traffic. Of considerable note was the landing of a pilot named J.B. Duckworth at Washington, D.C., then an Eastern Air Transport night mail flyer who flew by instruments a large way from New York, just before the storm closed down the airport. He would later become the first pilot to intentionally fly into a hurricane off the Texas coast in 1943.

Tidal flooding from the hurricane extended up the tributaries draining into the Chesapeake Bay as well. The James River at Surry, some 40 miles from Hampton Roads reached the highest level in recorded history at 10 a.m. on the morning of August 23, 1933 as the tidal surge swept away the Surry Pier serving the Surry-Jamestown Ferry. The tidal surge moved further up the James River flooding Hopewell and portions of the city of Richmond. River levels were generally three to five feet above normal from Hopewell westward into Richmond.

On the other side of the James River, waters were estimated to be five to eight feet higher than any previous high water mark in the city of Newport News. The York river also went on a rampage and surged into Gloucester Point at the extreme southern end of Gloucester County . The town Post Office and Drug Store were completely demolished. Four feet of water stood in the lobby of the Robbins Hotel.

Wave action from the hurricane turned the Assateague peninsula into an island. Ocean City inlet was carved out by this cyclone. Most of what was left of the tourist industry on the Virginia barrier islands disappeared. The hotel on

Cedar Island was destroyed. The clubhouses on Wallop's, Parramore, Revel's, Hog, Cobb's, Mockhorn, Skidmore, and Smith's Islands were badly damaged....and they never recovered. An inlet was formed at Ocean City that remains to this day (Assateague Naturalist). At least ten vessels met their fate in the hurricane.

The fifty-foot schooner yacht *Bluejacket* put out to sea from Sandy Hook, NJ on the 20th. As the boat sailed offshore, high northeast gales developed, and the ship headed for Atlantic City. At daybreak on the 21st, while just off Chincoteague, gales increased just before a lull...the hurricane's eye. Sixty to seventy foot waves knocked the *Bluejacket* around as the winds reached "terrific force" from the southwest... estimated at 100 mph. Pyramidal seas knocked down the masts and the rudder was carried away. Eventually, conditions improved and by the 24th, the *S.S. M&J Tracy* rescued the aimlessly drifting vessel, and the crew arrived at Newport News that night. Fewer than 18 perished in Virginia. Tens of millions of dollars of damage was incurred by the hurricane.

1933 September 16: On the 8th, a tropical storm was sighted 180 miles east of the Leeward Islands. It moved north, then northwest, as the Bermuda-Azores High re-established itself across the western Atlantic. Following a parabolic course, the hurricane made landfall near Cape Lookout on the morning on the 16th as a formidable category three hurricane on the Saffir-Simpson scale. The hurricane quickly recurved northeast, passing 80 miles east of Norfolk around noon (track to the left).

Heavy damage was seen with this storm in Virginia. Winds rose to 75 mph at Hampton Roads, 87 mph at Cape Henry, and 88 mph at Norfolk Naval Air Station. Tides reached 8.3 feet above mean lower low water at Sewells Point. This hurricane reshaped the peninsula where New Point Comfort lighthouse stood into an island.

1935 September 4-6 (Labor Day Hurricane): The most powerful hurricane ever known to strike the United States, this storm of small diameter moved across the Florida Keys, killing 400 people on its way into the Gulf of Mexico. Its pressure of 26.35", as it passed over the north end of Long Key, became a record low for a land based station in the Western Hemisphere. The system recurved into Tampa Bay and crossed through Georgia and the Carolinas before emerging back into the Atlantic near the North Carolina/Virginia border.

Southeast Virginia saw winds gusting between 40 and 50 mph. Several tornadoes touched down in eastern sections of the state. The most significant tornado tore its way from Portsmouth across Craney Island, western sections of Norfolk, and Willoughby Spit. The oil screw vessel *Co* burned off Chesterton, Maryland. The steamship *Fannie Mae* foundered in the storm one mile east of Windmill Point lighthouse. Three died due to the storm. One million in damages was exacted from Virginia.

1936 September 18:A tropical storm formed deep within the tropical central Atlantic. It moved west northwest, becoming a hurricane by the 11th. Storm motion slowed, as a nontropical low passed well to the north, causing the system to turn more towards the north. By late on the 12th, high pressure re-established itself to the northeast, and the hurricane resumed its northwest track. Recurving as it made landfall in the Outer Banks of North Carolina, the system accelerated northeast, passing just offshore Norfolk, Cape Cod, and Nova Scotia (track to the right).

This storm was one of the most severe in the history of Cape Hatteras. Norfolk experienced severe flooding. The highway from Currituck to Norfolk was washed out by heavy rains. Buena Vista along the James River set a record crest (22 feet), as did Westham (23.4 feet). Maximum sustained winds reached 68 mph at Hampton Roads and 84 mph at Cape Henry, before the anemometer failed. Tides rose to 9.3 feet above mean lower low water at Sewells Point. The schooner *Clemmie Tavers* was left stranded at Norfolk. Only one person lost their life to the storm.

1938 September 17-21 (Long Island Express): One of the fastest hurricanes ever known to move across the western Atlantic (Emily in 1987 the most recent tropical cyclone to challenge its title), this major hurricane went on to devastate New England. As the low began to take on some nontropical characteristics, its wind field expanded as it passed about 175 miles off the Virginia coast. Gusty winds of 50 to 60 mph blew by the Virginia Capes, even though the state was on the weak west wide of the hurricane. Roanoke's pressure fell to 28.62". Cape Henry was lashed by sustained winds of 57 mph.

A stationary front was located along the East Coast prior to the storm's arrival. When the hurricane approached, rain fell in torrents from Virginia northward. Some areas along the Eastern Shore recorded over eight inches of rain with the passage of this great hurricane. Losses were minor compared to the catastrophic losses incurred in New England.

1940 August 13-18: First observed between St. Martin and St. Thomas on the 5th, this tropical storm began to curve northwest, to the northeast of the Bahamas. Winds reached hurricane force at that time. A high pressure system built in to the north of the cyclone, forcing is on a more westward course to the near the Georgia/South Carolina border. The system meandered across the Southeast U.S. for four days, before becoming diffuse on the 15th.

Rains began in Virginia on the 13th, as the dying storm entered the state from the west. Deluges flooded locations statewide. Hampton Roads measured 4.76 inches. Emporia, on the Meherrin river, reached a flood of record on the 17th, when the stage crested at 31.50 feet, which was 8 ½ feet above flood stage. Mountain rivers and streams went on the rampage, washing out bridges and causing landslides which blocked roads. Several principal highways between Norfolk and southwest Virginia and Asheville were closed. A collision on the 13th involving the Oil Screw *F.B. Scarbrough* five miles above Coles Point may have been caused by this system. Sixteen died in the mountains of Virginia, Tennessee, and North Carolina due to the storm.

1944 September 14-15: A storm which moved northward along the eastern seaboard from North Carolina up to Newfoundland caused widespread damage (track to the left). Hampton Roads saw winds of 72 mph gusting to 90 mph. Winds of 134 mph sustained with gusts to 150 mph lashed Cape Henry...a wind record which remains standing today for the state. Virginia Beach saw the pressure fall to 28.80". The gas screw *May Dee* foundered off Ocean View. See the table below for other pressures reported across the region.

Rainfall from the storm caused a flood of record at State Farm on the James river (26.4 feet). Damage totaled $2.5 million. Forty-six perished. Also of note, this system was the first time that air force reconnaissance air craft were used to monitor a storm threatening the East Coast.

1949 August 28 (Delray Beach Hurricane): After devastating Florida with winds gusting to 160 mph, this cyclone tracked through Georgia and the Carolinas, where heavy rain caused river flooding (track of this storm above). One tornado touched down in Tidewater. Heavy rains spread northeast through New England, ending a long drought (Barnes II).

1953 August 13 (Barbara): Early on the 11th, a tropical storm was discovered in the southeastern Bahamas. It became a hurricane northeast of the Bahamas on the 11th and gained intensity as it moved north. At 10 p.m. on the 13th, it struck the North Carolina coast between Morehead City and Ocracoke (track to the right). The storm then moved north and northeast, before going out to sea just south of Norfolk.
Winds reached 63 mph with gusts to 76 mph at Norfolk. Winds at Cape Henry were sustained at 72 mph. Cape Henry lighthouse saw its copper canopy torn loose during the cyclone. Rainfall amounts of five to eight inches were common across southeast Virginia. Portsmouth saw 9.3" of rain deluge the city in only 24 hours.

1954 August 25-31 (Carol): Hurricane Carol, a major hurricane when it made landfall in North Carolina, moved northward into New England (track above and below). It moved 100 miles off the Virginia Capes and brought winds of 40 mph to Virginia Beach. Norfolk received four inches of rain. Chincoteague reported the lowest pressure...29.28". The system helped ease drought conditions in Washington, D.C..

1954 October 15 (Hazel): On the 4th, a tropical storm moved through the Windward Islands into the Caribbean Sea. It quickly formed into a hurricane and continued on a westerly track until the 10th. An upper low in the western Caribbean steered Hazel northward through the Mona Passage on the 12th. As the hurricane did so, heavy rains caused mudslides in Haiti which killed 500 people. Its track became northwesterly as a cold front approached from the Mississippi Valley. The hurricane then accelerated into northeast South Carolina as a category four hurricane. On the 15th, it passed over Raleigh, Richmond, and West Virginia (track to the left).

Considerable damage was done to residential and business property in Washington as sustained winds peaked at 78 mph with gusts to 98 mph. At National Airport, a light plane flipped over and part of the hangar was blown away. The Weather Bureau radar had to be turned off for three hours when the motor began to heat up. As a cold front interacted with Hazel, a squall line swept through Washington, D.C. at 6:15 p.m., dropping the temperature 20 degrees in one hour. Frost was seen in the suburbs the following night.

Hundreds of trees fell across the Federal City. Many store front windows shattered. Falling trees damaged many houses in Fairfax. Winds whipped up white caps on the Potomac. Waters overflowed the seawall at Hains Point. Alexandria saw the Potomac flood reclaim two blocks of the city, flooding basements and first floors of businesses. U.S. 1 was flooding by 9 p.m. at Hunting Creek. Heavy rains fell in the mountains, with a couple locations measuring over 10 inches.

Norfolk's sustained winds reached at 78 mph with gusts to 100 mph. Hampton saw winds as high as 130 mph. Damage was extensive from strong winds and high tides. Several ships in the James River were sunk or wrecked. At the Old Dominion Boat Club in Alexandria, two cruisers sank and several docks washed away. Quantico saw most of its docks vanish. Fourteen sailboats met an untimely fate at the Washington Sailing Marina. Tides reached 8.7 feet above low water datum at Washington, D.C..

The battleship *Kentucky* broke its moorings and ran aground 100 feet away. The gun screw vessel *Pirate* was lost off West Norfolk. The Coast Guard beacon light on the Potomac at Morgantown was toppled by Hazel's winds. Thirteen across Virginia perished...2 in the District of Columbia ...damage estimates reached $15 million.

1955 August 12 (Connie): Connie developed in the tropical middle Atlantic on the 4th, and moved west northwest to the north of Puerto Rico. Motion slowed on the 9th, as Connie began to interact with the developing Hurricane Diane. On the 11th, the system accelerated north- northeast and hit Cape Lookout, North Carolina (track to the right). It crossed the coast near Norfolk, emerging back into the Atlantic. Heavy rains and high winds were seen from North Carolina northward into New England.

Winds picked up on the upper Chesapeake Bay at 4 a.m., reaching gale force by daylight. The *Levi J. Marvel* was fighting the storm. When winds reached 50 mph, the canvas sails tore away. Twenty to twenty-five foot swells tormented the ship near Holland Point and it broke anchor. She took on water and capsized around 2:40 p.m.. Eleven drowned. The oil screw *La Forest L. Simmons* capsized 1 ½ miles north of Sharps Island Light in Maryland.

Norfolk's pressure fell to 28.77". The highest wind gusts were seen at Chincoteague, where winds peaked at 64 mph. National Airport at Washington D.C. reported sustained winds of 49 mph, with gusts to 58 mph, and 4.57" of rain. Power lines went down around the District. Scores of trees fell. Dozens of basements were flooded by the heavy rains. Eastern Virginia saw eight to ten inches of rain with Connie. Due to a drought which preceded the storm, any flooding was of minor consequence. Tides peaked at 6.6 feet above low water datum at Washington, D.C.. Four died in Rock Creek during the storm.

1955 August 17-18 (Diane): The category one hurricane named Diane caused heavy rains, compounding the flooding caused by Connie not even a week earlier. As Connie moved out to the north, Diane followed the storm and also struck North Carolina (track to the left). It passed west of Danville at 6 p.m.. The lowest pressure seen across Virginia was 29.48" at Lynchburg. Winds gusted to gale force across eastern Virginia and Washington D.C.. Winds peaked at 45 mph at Chincoteague. In the tidewater of Washington D.C., tide were four feet above normal... the peak level was 7.1 feet above mean lower low water on the morning of the 18th. Persistent east and southeast winds over the Chesapeake led to this condition.

The heaviest rain fell across northern Virginia, where amounts totaled over six inches. Several locations on the eastern slope of the Blue Ridge mountains recorded over a foot of rain. Flood stages were reached at most points in the Potomac Basin. Tides peaked at 7.0 feet above low water datum at Washington, D.C.. However, the heaviest flooding occurred along portions of the Shenandoah River Basin. High tides were also experienced, in addition to the rains. Damage in Virginia totaled $10.7 million. This hurricane produced over $686 million in damage, mainly due to its disastrous floods across the East Coast.

1955 September 19-20 (Ione): Ione was a major hurricane as it approached the Mid-Atlantic. Originally expected to move through Washington, D.C., the storm veered off to the right, proving to be far less of a menace than anticipated (track above). Sustained winds at Norfolk peaked at 47 mph with gusts to 58 mph. The pressure bottomed out at 29.13" (986 hPa). Total rainfall from the hurricane was 3.5". This cyclone gave a scare to the Mid-Atlantic, before it veered out to sea.

1956 September 27 (Flossy): This hurricane formed in the Gulf of Mexico and left a path of destruction from the Mouth of the Mississippi river through the Florida panhandle, Georgia, and South Carolina. As a nontropical gale, the system alleviated drought conditions across the region. Shortly after midnight, winds peaked at 45 mph in Washington, D.C.. One thousand phones were dead due to disabled phone lines. Three inches of rain fell across Virginia. Some streets in Norfolk were flooded with 2 ½ feet of water (Barnes II). The Back River lighthouse collapsed during the storm. The gas screw vessel *Mary Anne* was lost at Hampton Roads Naval Base.

1958 September 27 (Helene): Maximum sustained winds at Norfolk peaked at 41 mph with gusts to 56 mph as this hurricane moved by to the southeast.

1959 July (Cindy): Winds at Norfolk peaked at 45 mph with gusts to 46 mph. Small yet violent tornadoes were spawned by Cindy in Norfolk and Portsmouth. Over four inches of rain fell in Hopewell.

1959 September 30 (Gracie): This tropical cyclone initially struck the Atlantic coast south of Charleston, and moved west of Charlotte into western Virginia (track above). A tornado (one of three) touched down eight miles west of Charlottesville, killing 11. Heavy rains were seen in the Appalachians and near Norfolk. Norfolk saw 6.79" of rain in twenty-four hours. In all, twelve perished.

1960 September 11-12 (Donna): From the beginning, Donna was a ferocious storm. On August 29th, squalls in the vicinity of Dakar, in the country of Senegal on the west coast of Africa, forced the crash of an airliner, killing 63 aboard. The system moved out in the Cape Verde Islands on the 30th, and arrived at the Leeward Islands on the 4th. Amazing flash flooding was seen across the Virgin Islands and eastern Puerto Rico, when up to 15 inches of rain fell in less than four hours. Winds gusted to 180 mph across the Florida Keys, as the hurricane turned northward.

Thereafter, Hurricane Donna affected the entire length of the Atlantic coast of the United States. Donna became the first hurricane since complete records were kept in 1871 which traversed the Florida peninsula, the southeastern Unites States, the Mid-Atlantic region and New England.Donna made a second landfall between Wilmington and Morehead City on the evening of the 11th as a category three hurricane. The system tracked across the Albemarle and Pamlico sounds of North Carolina and re-emerged into the Atlantic Ocean just southeast of Virginia Beach shortly after 5:00 AM September 12, 1960. Above is a list of the lowest pressure measured in the region during Donna.

Virginia Beach saw the pressure fall to 28.51"...and winds gusted to 89 mph. Maximum sustained winds reached 73 mph at Norfolk and 80 mph at Cape Henry. The Chesapeake lightship estimated 138 mph winds as the pressure dove to 28.65". Eastern Virginia saw the most rain...where six to eight inches fell. The vessels *Peggy* and *Tender* were wrecked off Norfolk. Three died in Virginia due to Donna.

1964 August 29-September 1 (Cleo): This hurricane passed through the inland sections of the state from west to east. Washington, D.C. could only watch it rain to the south, as record drought plagued the area throughout much of the summer and fall. Southern sections of the Old Dominion saw inundating rains. In Tidewater Virginia, ten to fourteen inches of rain fell in about 12 hours. Two perished...both deaths were caused by motorists, who after being stranded in flood waters, were poisoned by carbon monoxide. Damages totaled $3 million.

1964 September 11-14 (Dora): As Dora moved northeast from Cape Hatteras out to sea 120 miles southeast of Norfolk, its influence was felt across southeast Virginia. Tides of three feet above normal in Hampton Roads caused moderate flooding of low lying areas. Heavy rain led to flooding at Suffolk and Yorktown. The heaviest rain was seen at Diamond Springs, 5.83 inches. Norfolk saw winds peak at 63 mph, causing minor damage. Near Cape Henry, a large freighter was driven aground.

1967 September 9-11 & 15-18 (Doria): An extreme example of how erratic a path of a hurricane can be, it remained near the southeast coast of the United States for 13 days, moving different directions every few days. As a hurricane on the 13th, it moved westward. The storm made landfall near the Virginia Capes before meandering south for a brief skirmish with North Carolina on the 17th, then eastward back out to sea.

Two periods of rain were associated with Doria in Virginia. The highest amount recorded was 4.66" at Lake Drummond, near Wallaceton. As the storm passed offshore the Virginia Capes by 225 miles on the 10th and 11th, winds gusted to a mere 36 mph at Norfolk. Cool air invaded the Mid-Atlantic. Washington, D.C.'s temperature fell to 49 degrees on the 11th.

The second approach on the 15th and 16th caused winds to gust to 55 mph...the pressure fell to 29.60" at Norfolk. Gusts to 60 mph were seen at Wallops Island on the 16th. Torrential rains and squalls buffeted the Eastern Shore. Winds damaged trees, roofs, signs, and billboards. Twenty to thrity foot seas came in advance of Doria's second coming towards Virginia. The superstructure of a 38-foot boat was torn off by high seas off the Atlantic coast near the Virginia/Maryland border...three perished from the vessel (Bailey). Tides were four feet above normal at Virginia Beach.

1969 August 19-20 (Camille): One of the strongest hurricanes ever recorded, Camille became Virginia's worst natural disaster ever. Camille weakened as it moved through the Southeast...until reaching the Appalachian mountains. As a cold front approached from the northwest, a burst of heavy rains developed across southeast West Virginia and western Virginia. To the right is a NIMBUS III satellite image of Camille just offshore the Mid-Atlantic on the 21st, provided by NCDC.

A band of rain and thunderstorms about 45 miles wide stretched from White Sulphur Springs, West Virginia to Fredericksburg. Rainfall increased rapidly along the west slopes of the Blue Ridge mountains; more than ten inches fell at Clifton Forge. In Nelson county, one location reported a whopping 27" of rain in only eight hours. This caused 133 bridges to be wiped out throughout Nelson county, making transportation nearly impossible. As Camille intensified back into a tropical storm over Virginia, four inches of rain fell along the coastal plain, in the path of the redeveloping storm.

When the rains began in earnest, telephone lines were downed, preventing the true nature of the flooding to the known until much later. Extensive flash flooding and landslides caused a major disaster on the Tye and Rockfish river basins. Landslides swept into hollows, destroying roads, homes, bridges, and railroads. Charlottesville was isolated as rock and mud slides blocked roads.

The James River experienced a flood of record as far downstream as Richmond. To the right is a table of values for different locations within the James River system. Buena Vista had 5 ½ feet of water in its business district. Glasgow, at the confluence of the Maury and James rivers, saw its entire business district destroyed by water nearly 14 feet deep. Flash flooding caused 153 people to perish, mainly across Virginia. The oil screw *Leader* foundered four miles east of Cape Henry. Damage totaled $113 million.

1970 May 26-27 (Alma): On the subsident side of the cyclone, at 1:15 p.m. on the 27th, a strong dust devil at Radford picked up a roof of a school hallway and dumped it onto the school grounds, injuring six.

1971 August 27 (A second Doria): A weak tropical depression formed in the eastern Atlantic and moved swiftly to the west, passing through the northern Leeward Islands on the 23rd, and moving just to the east of the Bahamas on the 25th. While recurving to the north, Doria became a tropical storm and continued to intensify as it approached the coast. Maximum sustained winds were 65 mph with the system as it made landfall in North Carolina (see track below).

Maximum sustained winds were 52 mph at Norfolk, 59 mph at Wallops Island, and 60 mph at Langley Air Force Base. A large warehouse near the Norfolk airport experienced severe damage. Appreciable losses were caused by a tornado as it tracked through Portsmouth and Chesapeake. Hundreds of trees fell and a dozen homes were damaged.

The highest rainfall amount was 6.44" two miles south-southeast of Halifax. Four-Mile Run flooded once more. A sewage plant in Virginia Beach became clogged with silt and sand. When the sewage was dumped into the Chesapeake, beaches were closed for days. A young girl drowned in Alexandria, when she fell into a drainage ditch.

1971 September 30-October 3 (Ginger): Tracked for 31 days as a cyclone through the Subtropical Atlantic, the very long-lived Ginger tormented Bermuda twice before moving west into North Carolina near Atlantic Beach. Maximum winds were under 50 mph across southern Virginia. Norfolk gusted to 49 mph from the northeast on the 30th. A few trees were leveled with isolated utility outages leading to minor inconvenience. The heaviest rains from the decaying tropical storm were seen in southeast Virginia. Diamond Springs reported a 7.49" deluge of rain. Tides ranged from two to four feet above normal. Moderate to heavy beach erosion ate away at Virginia Beach.

1972 June 21-22 (Agnes): Developing near the Yucatan peninsula of Mexico on the 15th, Agnes turned north and on the 16th attained hurricane status in the east-central Gulf of Mexico. A category one hurricane when it struck the Florida panhandle on the 17th, the storm weakened as it moved up the coast, east of the Appalachians. Pressures fell to 29.10" at Norfolk. Langley Air Force Base experienced wind gusts to 54 mph.

Big Meadows totaled 13.6" of rain from the decaying storm. The highest amount measured was 16" at Chantilly (See rainfall map to the upper right). An all-time 24 hour precipitation was set at Dulles Airport, when 11.88" deluged the area (Kocin). Associated severe flooding caused record river stages along the east half of the James River basin. Floods of record were recorded at Cartersville (37.87 ft.), the Richmond City Locks (36.5 ft.), and Richmond near Westham (28.62 ft.). This flood caused the James to swamp a 200 block area of downtown Richmond, the worst flooding since May 1771. Only one of the five bridges across the James was left usable. Moderate flooding occurred at Buena Vista.

Near Alexandria, Four Mile Run flooded the heavily populated section of Arlandria. Flooding was also severe along the Appomattox River Basin. The entire Potomac also flooded. Along the Potomac, 66 miles of towpath were scoured by the floods. Inundation led to a 300- foot cave-in at the Widewater section of the C & O Canal. Thousands of homes were flooded in Washington, D.C.. Even the White House experienced the wrath of Agnes, when heavy rains invaded its basement. Around 49,000 phones were put out of commission by downed lines. In the D.C. metropolitan area, ten people fell victim.

One hundred three highways were either destroyed or damaged across the state. The shellfish and oyster industry suffered due to excessive fresh water runoff into the Chesapeake destroying their marine habitat for weeks. Damage done across the state from Agnes totaled $222 million....$25 million in Fairfax county alone. The C & O Canal saw $34 million in damages. Thirteen died from flash flooding in Virginia.

As the storm moved northeast through New York, destructive floods and tornadoes surged the damage total to over $2.3 billion for the United States. The worst floods on record were experienced across Pennsylvania and southern New York, as over sixteen inches of rain fell in several locations.

1975 September 24-26 (Eloise): After striking the Florida panhandle as a major hurricane, Eloise accelerated inland and was downgraded to a tropical storm in Alabama (track above). Heavy rains began to fall across the Mid-Atlantic as Eloise interacted with a cold front. Street flooding was rampant in Virginia and Washington D.C.. The 9.08" of rain seen at Washington, D.C. from the cyclone led to the wettest September at the site since 1934. Flooding was experienced along the Patuxent River and Four-Mile Run. Arlandria experienced such a flood that 400 residents evacuated during the night of the 25/26th ($11.9 million).

Forty residences were submerged near Manassas, on Bull Run. Rock Creek Parkway was closed due to mud slides. Nearly 300 secondary and thirteen primary roads were closed due to the flooding statewide. Damage totaled $17.2 million.

1976 August 9 (Belle): A tropical wave moved offshore Africa on July 28th and moved uneventfully across the Atlantic and Caribbean Sea. A tropical depression formed on the north end of this wave on the 6th, in the vicinity of the northern Bahamas. Belle rapidly developed into a hurricane on the 7th. On the 8th, the system accelerated northeast and it made its closest approach to North Carolina on the 9th. It passed 85 miles east of Norfolk at 1 p.m. EST. Later that day, the fast moving storm made landfall on the coast of western Long Island.

Although on the weak west side of this hurricane, Virginia noted the passing of Belle. Pressures fell to 29.44" at Wallops Island...where winds of 60 mph were seen in gusts. Over four inches of rain fell along the immediate coast of Virginia. At South Island along the CBBT, winds peaked at 63 mph. One died in a related traffic accident in Norfolk.

1979 September 5 (David): David was a classic Cape Verde hurricane which caused massive destruction along its path across the western Atlantic. Dominica was the first island to experience David. Almost three-fourths of the population was left homeless by the cyclone. It was their strongest hurricane since 1834. As it moved westward across Puerto Rico, $70 million in damages was exacted from the island. Haiti was devastated the most by the borderline category 5 hurricane when heavy rains, mud slides, and high winds led to over 1,200 lost lives. Entire villages were swept away be the epic flood; the tempest caused $1 billion in damage across Hispaniola.

As the menacing storm continued its parabolic course, a brief landfall occurred at West Palm Beach. Now moving northward, the system moved just inland of the Atlantic Seaboard after its final landfall near Hilton Head, SC. When squalls passed through Virginia on the 5th, two powerful tornadoes tracked through Newport News and Hampton, causing $2.5 million in damage.

Most damage across the area was produced by gusty winds, as high as 60 mph. Trees and power lines were no match for David; this led to 140,000 people without power. A tornado touched down at the edge of Fairfax City at 7:22 p.m. on the 5th, severely damaging 22 homes ($2 million damage). This tornado lifted briefly, before touching back down at Great Falls. Eight tornadoes touched down from Fairfax and Loudon counties south to Newport News.

Many funnel clouds and weak tornadoes played havoc with Washington, D.C.. Winds only gusted to 39 m.p.h at National Airport; rains at that location totaled 3.68". Flooding was seen along Rock Creek, leading to the road's undermining ($374,000 damage). Floods also invaded the Alexandria waterfront. Heavy rains fell across the mountains of western Virginia and also in the vicinity of Norfolk. Big Meadows recorded 8.93" on the 9th while nine inches fell at Poor Mountain, near Roanoke. Flooding began around 9 p.m., inundating Colonial Heights-Petersburg, Rappahannock, Page, Madison, and Orange counties. Three perished in the storm. Total insured losses to the D.C. metropolitan area reached $8 million.

1985 July 25 (Bob): A tropical depression formed in the southeast Gulf of Mexico. It slowly meandered east, becoming a tropical storm just prior to making landfall across southwest Florida. As the system reached the east coast, it turned to the north. Hurricane status was achieved to the east of Georgia. The cyclone moved north into South Carolina, weakening quickly back into a tropical depression.

As the low moved north through Virginia, Bob spawned two weak tornadoes of F0 intensity and one strong tornado of F3 intensity. The two weak tornadoes near Richmond and Charlottesville damaged ten houses. The strongest tornado in northern Albermarle country destroyed two homes. Funnel clouds were observed throughout the Washington, D.C. metropolitan area. Gusty winds downed power lines, disrupting the Boy Scout jamboree in Fredericksburg. Winds peaking at 48 mph at National Airport downed a seaplane in the Washington Channel, near Hains Point, shortly before 2 p.m..

High winds and heavy rains damaged trees and led to a loss of power to 30,000 throughout the D.C. suburbs of Virginia and Maryland. A house under construction in Great Falls collapsed. Two people were fatally injured in Germantown, MD when a car slid into another vehicle while attempting to enter a curve. In the District, a man perished when his van struck an eastbound car. At 2 p.m., a car accident claimed a life near Calverton, MD.

1985 September 27 (Gloria): For ten days, this system gained intensity as it moved across the Atlantic, becoming an extremely dangerous and large category four hurricane east of the Bahamas (track to the left). As the storm accelerated north, cooler water temperatures caused weakening of the once powerful hurricane. Still, Gloria moved over Cape Hatteras at 2 a.m., where a pressure of 27.98" was achieved.

Virginia Beach saw the pressure bottom out at 28.87". Norfolk experienced winds sustained at 46 mph, with gusts to 67 mph. Norfolk Naval Air Station reported wind gusts of 64 mph. Sustained winds of 94 mph, with gusts to 104 mph, blew through South Island's Chesapeake Bay Bridge Tunnel (CBBT).

Hampton Roads saw a 5.65" deluge of rain. Southeast Virginia measured the most rain; isolated locales saw over eight inches. The highest tide noted was 5.3 feet above mean lower low water. Damage totaled $5.5 million statewide. This storm became nontropical in Canada and continued to rapidly move east. A record warm spell greeted Europe as Gloria made landfall on the continent early in October.

1985 November 2-7 (Juan/"Killer Flood of 1985"): This hurricane of non-tropical origin drifted aimlessly across Louisiana during the last week of October before moving east into Pensacola on Halloween. As the center of Juan moved north towards Michigan, a secondary low moved east across North Carolina, continuing the moderate rains. A third low pressure system, along Juan's cold front, transformed a minor flood into a major disaster. A massive rain shield developed as warm, tropical air overrode cooler air to the north of the center. This third system tracked across southwest Virginia on the 4th, and eventually through northern Virginia and Maryland.

Heavy rains fell across the eastern slopes of the Blue Ridge mountains...19.77" two miles northeast of Montebello. The Bloomington Reservoir rose 80 feet in a mere 30 hours. It was considered more damaging, further upriver than Agnes was in 1972. Record-breaking flood discharges occurred at many locations within the Potomac, James, and Roanoke river basins (Carpenter). The heart of the destruction was across Virginia and West Virginia. In Virginia, 3500 homes were destroyed. Carpeting, dead animals, window frames, and numerous household items began flowing down the Potomac. The most extensive damage in the Old Dominion occurred in the Roanoke river basin, in the Roanoke-Salem metropolitan area. Many in Roanoke were rescued from rooftops via boats and helicopters. Waters rose to the third story of an apartment complex in Salem. Lynchburg experienced the James rising to seven feet above the previous record, set in 1877. Stored tobacco was in ruin; losses totaled $8 million. Extensive flooding invaded Richmond. Monetary losses exceeded those of Camille and Agnes. Forty counties and twelve independent cities were declared Federal disaster areas.

Waters rose to within two inches of the top stones of Georgetown's Lock 3, stopping just shy of a catastrophe for Washington, D.C.. Waters were high for four days. Total damages along the C & O Canal from Cumberland to Georgetown was over $9 million. Overall, the Potomac saw $113 million in damages. In Virginia, 22 perished and $753 million of damage was incurred. In West Virginia, almost 2600 residents were left homeless after the floods, and damages skyrocketed to $500 million. It was the worst flood in West Virginia history as several small towns were almost destroyed (Stanton). Total damage across West Virginia, Virginia, Pennsylvania, and Maryland totaled $1.4 billion.

1986 August 17 (Charley): Forming as a tropical depression over the northeast Gulf of Mexico, the system wandered east and northeast to off the South Carolina coast before finally becoming a tropical storm. (track above and below). Charley briefly became a hurricane immediately off the Mid Atlantic coast. Norfolk saw winds of 40 mph, gusting to 63 mph. Cape Henry experienced sustained winds of 54 mph with gusts to 82 mph. South Island's CBBT saw hurricane conditions as 94 mph sustained winds, with gusts to 104 mph, lashed the station.

A light twin engine plane crashed into the Chesapeake Bay at around 7 p.m., killing all three aboard. Tides rose to 5.5 feet above mean lower low water. Damage totaled less than $1 million statewide.

1989 September 21-22 (Hugo): Hugo was a well organized tropical disturbance as it emerged off the coast of Africa. It developed modestly as it crossed the ocean and became a category five hurricane as it approached the northeastern Caribbean Sea. Puerto Rico took its toll on Hugo (and vice versa) and Hugo weakened into a minor hurricane. Over the next few days, the system re-attained hurricane status and strengthened rapidly in the hours before landfall near Charleston. The track of Hugo then took a northward turn, across western Virginia, before transitioning into a nontropical low (track to the upper right, satellite picture to the upper left provided by NCDC). Winds peaked at 37 mph at National Airport. The low pressure system later merged with a cold front. Six died in Virginia due to Hugo.

1990 October 11-13 (Klaus & Marco): Klaus, once a hurricane northeast of the Caribbean, moved west-northwest to the north of the Greater Antilles as a weakening, sheared tropical storm. At this time, Marco was forming in the Florida Straits. The two low pressure systems moved in tandem on opposite sides of the Florida peninsula. The remains of Klaus came ashore along the east coast, accelerating northward into the Appalachians. Meanwhile, Marco limped ashore the Florida panhandle and moved slowly northeast. The combination of these two systems dropped around eight inches of rain to the mountains of western Virginia.

1994 August 17-18 (Beryl): This tropical storm formed very close to the Florida panhandle on the 14th. Landfall took place near Panama City at 8 p.m. EST on the 15th. Thereafter, the cyclone weakened to a tropical depression and moved northeast. Around five inches of rain fell across western Virginia. Heavy rains spread northeast to New York state. One tornado touched down just north of Ridgeway and tracked 4 1/4 miles. One hundred homes and thirty businesses were damaged along its path, and ten people were injured ($8.7 million).

Seven inches of rain fell in Carrol and Grayson counties, flooding roads and low bridges. Flood waters on Kerrs Creek sent one family evacuating. Evacuations also took place near the New River in Pulaski county. Roads in western Augusta county were closed. Faquier county saw mud and gravel slides damage and close roads. Over twenty roads were flooded in Shenandoah county. Winchester was inundated in a foot and a half of standing water. Damages totaled $15 million statewide.

1995 August 6-7 (Erin): The remains of Erin spread eastward from the Ohio Valley across West Virginia, northern Virginia, and Maryland. Almost six inches of rain fell in some areas of extreme northwest Virginia. It caused brief relief from an otherwise excessively hot and dry July, August, and early September. A tornado was spawned near the Patuxent Naval Research Center.

1995 October 5 (Opal): After accelerating northward out of the Gulf of Mexico, Opal moved quickly through the Eastern United States. The satellite picture to the left was taken as the cyclone was accelerating through northwest Gerogia at 4 a.m. on the 5th, provided by NCDC. Despite hundreds of miles of travel from the Gulf of Mexico, gale force winds blew through western Virginia. Winds sustained at 40 mph, with gusts past 60 mph, blew down trees mainly above 2000 feet elevation in the Shenandoah Valley and along the Allegheny Plateau. Dozens of trees were blown down along Skyline Drive in Page and Warren counties.

In Waynesboro, a canopy over a service station was ripped off. South Winchester and Elkton saw 2600 homes and businesses without power as lines were downed by the winds. Two tornadoes struck the tidewater. One touched down at West Point airport in New Kent county. It tore the roof off a hangar, destroying a small airplane and damaging four others. The second tornado uprooted trees and damaged outhouses.

In Madison county, five inches of rain fell on Graves Mountain, washing out a bridge previously destroyed by floods that June. A minor mudslide occurred in Grayson county. A vehicle was swept off the road by flood waters six miles southwest of Fancy Gap in Carroll county. Washington, D.C. saw local street flooding from the system's rainfall. Four to eight inches of rain fell across southwestern Virginia. This helped end drought conditions brought on from a very dry July, August, and September. Damage totaled $220,000.

1996 July 12-13 (Bertha): The earliest Cape Verde hurricane ever witnessed to cross the Atlantic unscathed, unprecedented Bertha lashed the Mid Atlantic coast (track below). To the right is an image of the hurricane as it was making landfall in North Carolina, provided by the National Climatic Data Center (NCDC). Portsmouth reported winds gusting to 54 mph on the 13th... the pressure fell to 29.37". Tree limbs falling on power lines caused temporary power outages. Over four inches of rain fell across southeastern Virginia.

1996 September 5-8 (Fran): The major hurricane known as Fran struck the North Carolina coast between Wrightsville and Topsail beaches (track to the upper left, satellite picture to upper right courtesy of NCDC). Extensive flooding was endured from North Carolina and Virginia northward, as the center passed over Danville. Widespread flooding occurred in the mountains. Norfolk saw southeast winds of 41 mph, with gusts to 47 mph. At Portsmouth, winds peaked at 60 mph at 4:19 a.m.; the pressure fell to 29.67". The storm raged more severely at Hampton, where gusts to 71 mph occurred.

Lynchburg experienced a 6.94" deluge of rain. Tom's Branch received 14.3"...causing flash flooding which cut the city off from the rest of the area. The town of Luray was split in half by flooding. Columbia saw winds of 46 mph. In all, 360,000 lost power due to the cyclone. In Washington, D.C., power lines and trees were downed. Fourteen inches of rain fell in isolated locations southwest of the city. To the left is a picture of flooding in Alexandria, courtesy of the Associated Press. Along the C & O Canal, the devastating flood swept through Harpers Ferry and Point of Rocks. A Virginia woman perished as her all-terrain vehicle was swept away, while crossing a flooded creek. Three perished due to Fran.

1997 July 24 (Danny): This hurricane made landfall in southeast Louisiana before stalling in Mobile Bay for over 24 hours. Thereafter, it moved north into western Alabama before making a hard right towards the east across the lower Appalachians. While the system was in transit across the length of North Carolina, it restrengthened into a tropical storm. It later emerged into the Atlantic near Pungo, Virginia.

The pressure fell to 29.73" at Portsmouth as winds gusted to 56 mph at 3:17 p.m.. Norfolk Naval Air Station experienced wind gusts to 67 mph. Langley Air Force Base, the Chesapeake Bay Bridge Tunnel, and Cape Henry gusted to 61 mph. Trees and power lines were downed throughout the Norfolk metropolitan area. At 1:09 p.m., a tornado touched down in the South Norfolk section of Chesapeake or about two miles east of Portsmouth and destroyed a car wash, along with six other businesses. A tractor trailer was overturned. Another tornado near Norfolk destroyed windows and tracked a mile east across the eastern branch of the Elizabeth River. A third tornado touched down at Knotts Island.

1998 August 27-28 (Bonnie): This hurricane formed in the tropical Atlantic before recurving to move over the Outer Banks. Portsmouth gusted to 63 mph while the pressure fell to 29.53". Norfolk experienced winds of 46 mph with gusts to 64 mph. Winds howling to 90 mph blew past the Cape Henry Light Station. South Island CBBT had 90 mph with gusts to 104 mph. The combination of four to seven inches of rain and high winds knocked out power to nearly 1,000,000 people...most of which were in the vicinity of Hampton Roads. Tides peaked at 6.0 feet above mean lower low water.

1999 August 29-September 7 (Dennis): On the 22nd, a tropical disturbance formed north of Puerto Rico. Over the next two days, the system gradually became a tropical depression while located near the southeasternmost Bahamas. Strengthening was slow to ensue to to upper level westerly winds inhibiting development. Despite the shear, Dennis became a tropical storm on the night of the 24th, as it drifted west-northwest.

The cyclone was in a state of constant reorganization through the 26th, but slowly intensified into a hurricane by that morning while located in the central Bahamas. An upper level trough swung through the northern Plains and into the Northeast over succeeding days. This allowed the storm to turn slowly to the north, while continuing to strengthen. It came perilously close to Wilmington, North Carolina during the night of the 29th before finally moving northeast, paralleling the coast. To the left is a satellite picture showing this hurricane near the time of its closest first approach, at 11:15 a.m. on the 30th.

Cold and dry air began to envelop the system during the night of the 30th, leading to a collapse of all the deep convection (thunderstorm activity) around the system. Weakening began soon after, returning to category one status by the morning of the 31st, and a tropical storm late that night. Showers and thunderstorms temporarily redeveloped each day, keeping the system at tropical storm strength. The cyclone then meandered slowly west from the 1st through the 3rd...before accelerating during the day of the 4th into southeast North Carolina, as it reintensified into a strong tropical storm. After landfall that night, Dennis moved westward into central North Carolina, finally reaching the Old Dominion late on the night of the 5th as a weakening tropical depression. On the 6th, it accelerated northward across the state.

Gale-force winds were experienced along the coasts of North Carolina and Virginia from the night of the 29th through the 31st. On the 4th, gusts to gale force redeveloped along the Virginia coast. As the center approached North Carolina, a tornado touched down in Chesapeake at 11:15 a.m. on the 4th, damaging two buildings. The second tornado, in Hampton at 1:21 p.m. was the most menacing. Ten cars and an eighteen-wheel truck overturned.

Three nursing and retirement homes were struck...sending their residents for safer shelter. Many homes lost their roofs. Six people were injured from this tornado.

Rainfall amounts for the past week in southeast Virginia approached seven inches for the entire event. The highest rainfall total reported was 9.25" at Upper Shernando. As of 1 a.m. on the 6th, Apple Orchard Mountain in Bedford county had measured 8.83". Other locations that measured over seven inches of rain included Monterey, Toms Branch, Montebello, Sugar Grove, and Big Meadows. The tropical deluge affected areas from North Carolina northward to Pennsylvania, as of the 6th. High tides invaded Norfolk/Virginia Beach by the morning of the 31st...3.1 feet above normal at 8 am on the 31st, but they slowly receded over following days.

The highest gust reported in Virginia was 54 mph at Norfolk Naval Air Station at 5:06 p.m. EDT on the 30th. The lowest pressure seen in the Old Dominion thus far has been 29.77" at Norfolk at 4:25 p.m. on the 4th.

1999 September 16 (Floyd):. Passed directly over Virginia Beach on a track similar to Hurricane Donna in1960. Lowest pressure of 28.85" (977 MB) at Norfolk Int'l Airport 4th lowest for a hurricane this century. Fastest 1 minute wind NE 31mph with gust to 46 mph. Rainfall 6.80" with amounts of 12-18" in interior portions eastern Virginia. Franklin, VA reported 500 year flood of record. Largest peacetime evacuation in U.S. History.

TWENTY-FIRST CENTURY

2003 September 18 (Isabel): Made landfall near Ocracoke NC. The center passed west of Emporia and west of Richmond. Fastest 1 minute wind speed NE 54 mph with gusts to 75 mph at Norfolk NAS; NE 61 mph with gusts to 74 mph at the South Island CBBT. Highest tide at Sewells Point was 7.9 feet above MLLW, which was a 5 ft surge. Significant beach erosion was reported. Numerous trees and power lines down over a wide area, with over 2 million households without power in VA. VA damage was over $625 million, and there were over 20 deaths in VA.

2004 August 3 (Alex): made its closest approach to land on August 3, 2004 with its center located about 9 nm southeast of Cape Hatteras/Outer Banks, NC as a Category 1. Alex produced locally heavy rainfall across portions of southeast Virginia, but little in the way of damage or flooding.

2004 August 14 (Charley): made a second landfall near Cape Romain, SC as a weakening Category 1, after devastating portions of central and southwest Florida. Charley brought locally heavy rainfall and strong winds to much of southeast Virginia, especially near the coast. A wind gust to 72 mph was recorded at the Chesapeake Light buoy. In the U.S., 10 deaths and $14 billion in damage resulted from Charley.

2004 August 30 (Gaston): made landfall near Awendaw, SC, on August 29, 2004 as a Category 1. Gaston weakened as it lifted northward through North Carolina, then northeastward across southeast Virginia on August 30th. Gaston produced a swath of 5 to 14 inch rains extending from Lunenburg and Mecklenburg counties northeast into Caroline and Essex counties. The heaviest rainfall, centered on the Richmond metro area, produced a major flash flood which killed 8 people. Five of these deaths resulted from people driving into flooded roadways. A total of 13 tornadoes were observed in central and eastern Virginia, all producing F0 damage. Total damage is estimated at $130 million.

2004 September 8 (Frances): made landfall over east central Florida as a Category 2. It then moved northeast into the northern Gulf of Mexico, eventually turning north, making a second landfall in the panhandle of Florida, and then weakening into a tropical depression. It tracked through western Virginia, then northeast and offshore the mid Atlantic coast. A total of 6 tornadoes were observed in central and eastern Virginia, the strongest producing F1 damage.

2004 September 17 (Ivan): made landfall near the Florida/Alabama border as a category 3. It weakened to a tropical depression, and moved northeast, tracking along the Appalachian Mountains through western Virginia, then northeast and offshore the mid Atlantic coast. A total of 40 tornadoes were produced in Virginia, most in central and northern Virginia. This was a record single day outbreak for Virginia, and exceeded the previous ANNUAL tornado record (31). Most of these tornadoes were F0 or F1 in intensity, although 10 F2 tornadoes and 1 F3 tornado touched down in south central…west central and northern Virginia.

Hurricanes come close enough to produce hurricane force winds approximately three times every 20 years. Two or three times a century winds and tides produce considerable damage and significantly threaten life. Three known storms have been powerful enough to alter coastal features.

MLLW = Mean Lower Low water which is the mean of the lowest of the low tide values.

Bibliography for Appendix C

Assataeague Naturalist. The Great Hurricane of 1933. World Wide Web, 1998.

Bailey, Morton H.: "Special Weather Summary" Climatological Data Virginia : September 1967. Environmental Science Services Administration: Asheville, 1967.

Barnes, Brooks M., Barry R. Truitt. Seashore Chronicles: Three Centuries of the Virginia Barrier Islands. University Press of Virginia: Charlottesville, 1997.

Barnes, Jay. North Carolina's Hurricane History. University of North Carolina Press: Chapel Hill, 1995.

_____. Florida's Hurricane History. University of North Carolina Press: Chapel Hill, 1998.

Carpenter, D. H.. Floods in West Virginia, Virginia, Pennsylvania, and Maryland, November 1985. U.S. Geological Survey Water-Resource Investigations Report 88-4213: Towson, 1990.

Cobb, Hugh D. "The Chesapeake-Potomac Hurricane of 1933" Weatherwise: Heldref Publications: Princeton, 1991.

Crappuli, Robert. Hurricane and Tropical Storm Data: 1600-present...Georgia and South Carolina Storms. World Wide Web, 1998.

Crockett, Curtis W.: "Special Weather Summary" Climatological Data Virginia: August 1971. Environmental Data Service: Asheville, 1971.

Environmental Science Services Administration. Hurricane Camille: August 14-22, 1969. Department of Commerce: Washington D.C., 1969.

Fernandez-Partagas, J., Henry Diaz, 1996. A Historically Significant Revision of Atlantic Tropical Cyclone Frequency 1851 to 1890. Climate Diagnostics Center, ERL/NOAA, 62 pp.

Green, Timothy. "Frederickfburg, July 31" Virginia Herald and Fredericksburg Advertiser 31 July 1788: 3. _____. "Frederickfburg, August 7" Virginia Herald and Fredericksburg Advertiser 7 August 1788: 3. _____. "Fredericksburg, August 4" Virginia Herald, and Fredericksburg Advertiser 4 August 1795: 3. _____. "Norfolk, August 12" Virginia Herald, and Fredericksburg Advertiser 21 August 1795: 2.

Henry, Alfred J.. "Climatological Tables" Monthly Weather Review August 1928. Government Printing Office: Washington, 1929.

High, Mike. The C & O Canal Companion. Johns Hopkins University Press: Baltimore, 1997.

House, Donald C. The Virginia Floods: August 19-22, 1969. Environmental Science Services Administration: Washington D.C., 1969.

Hutchins, Stilson. "Very Welcome Rain" Washington Post 10 September 1881: 1. _____. "The Coming Cold Wave" Washington Post. 11 September 1881: 1. _____. "Damage by the Storm" Washington Post 12 September

1882: 3. _____. "Alexandria Annals" Washington Post 13 September 1882: 3. _____. "A Destructive Storm" Washington Post 24 September 1882: 1. _____. "The Equinoctial" Washington Post 25 September 1882: 1.

Hutchins, Stilson. "Welcome Rain in Virginia" Washington Post 12 September 1883: 1. _____. "Wreck of the Norfolk and Western" Washington Post 13 September 1883: 1. _____. "Virginia Peanuts a Failure" Washington Post 16 September 1883: 1. _____. "A Widespread Storm" Washington Post 26 August 1885: 1. _____. "Panic on a Steamer" Washington Post 27 August 1885: 1. _____. "A Widespread Storm" Washington Post 14 October 1885: 5.

Jennings, Arthur H. Technical Paper No. 16: Maximum 24-Hour Precipitation in the United States. Hydrologic Services Division: Washington D.C., 1952.

Kocin, Paul J. Tropical Cyclones in the Northeast United States. Unpublished: Camp Springs, 1995.

Kutschenreuter, Paul H. Technical Paper No. 26: Hurricane Rains and Floods of August 1955 Carolinas to New England. Department of Commerce: Washington D.C., 1956.

Lewis, Clifford M., Albert J. Loomie. The Spanish Jesuit Mission in Virginia 1570-1572. University of North Carolina Press: Chapel Hill, 1953.

Ludlum, David M. Early American Hurricanes: 1492-1870. American Meteorological Society: Boston, 1963. _____. Weather Record Book. Weatherwise: Princeton, 1971.

Morton, Robert A. An Overview of Coastal Land Loss: With Emphasis on the Southeastern United States. USGS Open File Report 03-337. Online at: http://pubs.usgs.gov/of/2003/of03-337/waves.html.

National Climatic Data Center. May 1970 Storm Data. NESDIS: Asheville, 1970. _____. August 1971 Storm Data. NESDIS: Asheville, 1971. _____. September 1971 Storm Data. NESDIS: Asheville, 1971. _____. June 1972 Storm Data. NESDIS: Asheville, 1972. _____. September 1975 Storm Data. NESDIS: Asheville, 1975. _____. August 1976 Storm Data. NESDIS: Asheville, 1976. _____. September 1979 Storm Data. NESDIS: Asheville, 1979. _____. August 1994 Storm Data. NESDIS: Asheville, 1994. _____. October 1995 Storm Data. NESDIS: Asheville, 1996. _____. July 1997 Storm Data. NESDIS: Asheville, 1996.

NWSO Wakefield, VA. The Hurricane History of Coastal Virginia. National Weather Service: Wakefield, 1998. _____. The Hurricanes of the 1930s in Virginia and North Carolina. World Wide Web, 1998. _____. The Hurricanes 1950-1954 in Virginia and North Carolina. World Wide Web, 1998.

Office of Meteorological Operations. Hurricane Agnes: June 14-22, 1972. National Weather Service: Silver Spring, 1972. _____. Hurricane Fran. National Weather Service: Silver Spring, 1996.

Pouliot, Richard A., Julie J. Pouliot. Shipwrecks on the Virginia Coast and the Men of the United States Life-Saving Service. Tidewater Publishers: Centreville, 1986.

Proctor, John Clogett. "New York Avenue Church" Sunday Star 21 March 1948: Washington. _____. "Storm Fury Faced By Churches Here" Sunday Star 30 September 1934: Washington.

Richards, George and Company. Virginia Journal and Alexandria Advertiser 6 October 1785: Alexandria, 3.

Ryan, Bob. Bob Ryan's 1991 Weatherwise Almanac. WRC-TV: Washington, 1991.

Secretary of the Army. Washington, D.C., Metropolitan Area: Letter from the Secretary of the Army Transmitting a Letter From the Chief of Engineers, Department of the Army, Dated April 28, 1964, Submitting a Report, Together

With Accompanying Papers and an Illustration, on an Interim Hurricane Survey of Washington, D.C., Metropolitan Area, Authorized by Public Law 71, Eighty-Fourth Congress, Approved June 15, 1955. U.S. Government Printing Office: Washington, 1964.

Shomette, Donald G. Shipwrecks of the Chesapeake: Maritime Disasters on Chesapeake Bay And Its Tributaries, 1608-1978. Tidewater Publishers: Centreville, 1982.

Stanton, Richard L. Potomac Journey: Fairfax Stone to Tidewater. Smithsonian Institution Press: Washington, 1993.

Stevenson, James D. A Historical Account of Tropical Cyclones that Have Impacted North Carolina Since 1586. NOAA Technical Memorandum NWS ER-83: Bohemia, 1990.

Tannehill, Ivan R. Hurricanes. Princeton University Press: Princeton, 1943.

Trotter, William. Hurricane Bertha Storm Report Portsmouth, Virginia. PWRS: World Wide Web, 1996. _____. Hurricane Fran Storm Report Portsmouth, Virginia. PWRS: World Wide Web, 1996. _____. Tropical Storm Danny Visits Portsmouth! PWRS: World Wide Web, 1997. _____. Hurricane Bonnie 1998! PWRS: World Wide Web, 1998.

U.S. Department of Commerce. Weather Bureau Technical Paper No. 2: Maximum Recorded United States Point Rainfall. Weather Bureau Analysis Center: Washington, D.C., 1947. _____. Climatological Data Virginia: September 1959. Weather Bureau: Asheville, 1959. _____. Climatological Data Virginia: October 1959. Weather Bureau: Asheville, 1959. _____. Climatological Data Virginia: August 1964. Weather Bureau: Asheville, 1964. _____. Climatological Data Virginia: September 1964. Weather Bureau: Asheville, 1964. _____. Hurricane Cleo: August 20-September 4, 1964. Weather Bureau: Washington D.C., 1964. _____. Climatological Data Virginia: September 1971. Environmental Data Service: Asheville, 1971. _____. Climatological Data Virginia: October 1971. Environmental Data Service: Asheville, 1971.

Vojtech, Pat. Lighting the Bay: Tales of Chesapeake Lighthouses. Tidewater Publishers: Centreville, 1996.

Washington Post Company. "Heavy Rain in Lynchburg" Washington Post 23 June 1886: 1. _____. "Great Floods in Virginia" Washington Post 3 July 1886: 1. _____. "A Cyclone Off Cape Henry" Washington Post 23 August 1887: 1. _____. "Ruin of Wind and Rain" Washington Post 22 August 1888: 1. _____. "The Edge of a Tornado" Washington Post 22 August 1888: 2. _____. "In the Storm's Pathway" Washington Post 23 August 1888: 1. _____. "Death at a Colored Baptizing" Washington Post 24 August 1888: 2. _____. "Drouth Followed by Flood" Washington Post 12 September 1888: 2. _____. "British Schooner Wrecked" Washington Post 13 September 1888: 2. _____. "The First Winter Storm" Washington Post 26 November 1888: 1. _____. "Out of Death's Jaws" Washington Post 27 November 1888: 1. _____. "A Strange April Day" Washington Post 7 April 1889: 2. _____. "Wind, Water and Fire" Washington Post 8 April 1889: 1. _____. "A Storm's Fury" Washington Post 12 September 1889: 1. _____. "Wrecks on the Seashore" Washington Post 13 September 1889: 1. _____. Washington Post 14 September 1889: 1. _____. "Caught in a Storm" Washington Post 25 September 1889: 1. _____. "Will Be a Total Loss" Washington Post 11 October 1891: 1. _____. "Struck By a Storm" Washington Post 29 August 1893: 1. _____. "Scores Were Lost" Washington Post 30 August 1893: 1-2.

Appendix D
Hazard Ranking Sheets

Hampton - Priority of Hazards

Methodology

Hazards were identified and prioritized through an exercise that was conducted with the City of Hampton, VA . In the exercise participants were asked to identify natural hazards that occur in the City of Hampton and rank the selected hazards from highest to lowest priority. The results of those exercises are included in the table below titled "Prioritization of Hazards for the City of Hampton." The priority hazards were determined using a combination of historical occurrences, public perception of hazard risk, and the probability of future occurrence based on other technical resources.

Hazard	**Probability of Occurrence**	[1]**Public Perception of Occurrence**	**Historical Occurrence**	**References**
NATURAL HAZARDS				
Winter Weather	L	M		HMPC, FEMA, NCDC
Thunderstorm / Lightning	M-H	M-H		HMPC, NOAA-NCDC
Wind	M	H		HMPC, NOAA-NCDC
Hurricanes	M	H[2]		HMPC
Tornadoes	L	L		HMPC
Drought	L	M		HMPC
Earthquakes	N	L		HMPC, USGS
Landslides	N	N		HMPC
Sea Level Rise	L	L		HMPC
Wildfires	L	L		HMPC
Biological Hazards	L	L		HMPC
Floods - Riverine3	M	H		HMPC, FEMA, NCDC
Floods - Coastal	M	H		HMPC, FEMA, NCDC
H=High; M=Moderate; L=Low; N=No; N/A=Not Applicable, Unknown=Historical Data Unavailable; OEM=City of Newport News Office of Emergency Management; NCDC=National Climatic Data Center; FEMA=Federal Emergency Management Agency; USGA=United States Geological Survey; MHA=Multi-Hazard Atlas				

[1] Back up with a survey using the “ Household Natural Hazards Preparedness Questionnaire “
[2] Post Floyd and Isabel
[3] Flash Floods

Newport News - Priority of Hazards

Methodology

Hazards were identified and prioritized through an exercise that was conducted with the City of Newport News, VA . In the exercise participants were asked to identify natural hazards that occur in the City of Newport News and rank the selected hazards from highest to lowest priority. The results of those exercises are included in the table below titled "Prioritization of Hazards for the City of Newport News." The priority hazards were determined using a combination of historical occurrences, public perception of hazard risk, and the probability of future occurrence based on other technical resources.

Hazard	Probability of Occurrence	Public Perception of Occurrence	Historical Occurrence	References
NATURAL HAZARDS				
Winter Weather	M	M	M	HMPC.FEMA, NCDC
Thunderstorm / Lightning	L	L	L	HMPC,NOAA-NCDC
Wind	M	H	M	HMPC,NOAA-NCDC
Hurricanes	L	M	L	HMPC
Tornadoes	L	L	L	HMPC
Drought	L	L	L	HMPC
Earthquakes	L	L	L/NO	USGS
Landslides	L	L	NO	HMPC
Sea Level Rise	L	L	L	HMPC
Wildfires	L	L	L	HMPC
Biological Hazards	L	M	L	HMPC
Floods - Riverine	M/H	H	M/H	HMPC, FEMA, NCDC
Floods - Coastal	H	H	H	HMPC, FEMA, NCDC
Dam Failures	L	L	NO	HMPC
H=High; M=Moderate; L=Low; N=No; N/A=Not Applicable, Unknown=Historical Data Unavailable; HMPC = Newport News Hazard Mitigation Planning Committee; OEM=City of Newport News Office of Emergency Management; NCDC=National Climatic Data Center; FEMA=Federal Emergency Management Agency; USGA=United States Geological Survey; MHA=Multi-Hazard Atlas				

Williamsburg - Priority of Hazards

Methodology

Hazards were identified and prioritized through an exercise that was conducted with the City of Williamsburg, VA . In the exercise participants were asked to identify natural hazards that occur in the City of Williamsburg and rank the selected hazards from highest to lowest priority. The results of those exercises are included in the table below titled "Prioritization of Hazards for the City of Williamsburg." The priority hazards were determined using a combination of historical occurrences, public perception of hazard risk, and the probability of future occurrence based on other technical resources.

Hazard	Probability of Occurrence	Public Perception of Occurrence	Historical Occurrence	References
NATURAL HAZARDS				
Winter Weather	M	M	M	HMPC, FEMA, NCDC
Thunderstorm / Lightning	H	H	H	HMPC, NOAA-NCDC
Wind	L	L	L	HMPC, NOAA-NCDC
Hurricanes	L	L	L	HMPC
Tornadoes	L	L	L	HMPC
Drought	L	L	L	HMPC
Earthquakes	L	L	L	HMPC, USGS
Landslides	L	L	L	HMPC
Sea Level Rise	L	L	L	HMPC
Wildfires	L	L	L	HMPC
Biological Hazards	L	L	L	HMPC
Floods - Riverine	M	L	M	HMPC, FEMA, NCDC
Floods - Coastal	L	L	L	HMPC, FEMA, NCDC
Dam Failures	L	L	L	
H=High; M=Moderate; L=Low; N=No; N/A=Not Applicable, Unknown=Historical Data Unavailable; HMPC= Williamsburg Hazard Mitigation Planning Committee; OEM=City of Williamsburg Office of Emergency Management; NCDC=National Climatic Data Center; FEMA=Federal Emergency Management Agency; USGA=United States Geological Survey; MHA=Multi-Hazard Atlas				

James City County - Priority of Hazards

Methodology

Hazards were identified and prioritized through an exercise that was conducted with James City County, VA. In the exercise participants were asked to identify natural hazards that occur in James City County and rank the selected hazards from highest to lowest priority. The results of those exercises are included in the table below titled "Prioritization of Hazards for James City County." The priority hazards were determined using a combination of historical occurrences, public perception of hazard risk, and the probability of future occurrence based on other technical resources.

Hazard	**Probability of Occurrence**	**Public Perception of Occurrence**	**Historical Occurrence**	**References**
NATURAL HAZARDS				
Winter Weather	H			HMPC, FEMA, NCDC
Thunderstorm / Lightning	H			HMPC, NOAA-NCDC
Wind	H			HMPC, NOAA-NCDC
Hurricanes	H			HMPC
Tornadoes	H			HMPC
Drought	H			HMPC
Earthquakes	L			HMPC, USGS
Landslides	L			
Sea Level Rise	L			HMPC
Wildfires	L			HMPC
Biological Hazards	L			
Floods - Riverine	L			HMPC, FEMA, NCDC
Floods - Coastal	L			HMPC, FEMA, NCDC
Dam Failures				
H=High; M=Moderate; L=Low; N=No; N/A=Not Applicable, Unknown=Historical Data Unavailable; HMPC = James City Hazard Mitigation Planning Committee; OEM=James City County Office of Emergency Management; NCDC=National Climatic Data Center; FEMA=Federal Emergency Management Agency; USGA=United States Geological Survey;				

York County - Priority of Hazards

Methodology

Hazards were identified and prioritized through an exercise that was conducted with York County, VA . In the exercise participants were asked to identify natural hazards that occur in York County and rank the selected hazards from highest to lowest priority. The results of those exercises are included in the table below titled "Prioritization of Hazards for York County." The priority hazards were determined using a combination of historical occurrences, public perception of hazard risk, and the probability of future occurrence based on other technical resources.

Hazard	**Probability of Occurrence**	**Public Perception of Occurrence**	**Historical Occurrence**	**References**
NATURAL HAZARDS				
Winter Weather	L	M	1998	HMPC, FEMA, NCDC/NWS/Newspaper
Thunderstorm / Lightning	H	H		HMPC, NOAA-NCDC/Newspaper
Wind	M	L	1990-2003	HMPC, NOAA-NCDC/NWS
Hurricanes	M	M	1999-2003	HMPC, NWS/Newspaper
Tornadoes	L	L	2003	HMPC, NWS/Newspaper
Drought	L	L	2002	HMPC, NWS/Newspaper
Earthquakes	L	L	1995	HMPC, USGS/Newspaper
Landslides	L	L	N/A	NONE
Sea Level Rise	H	L		HMPC, VIMS/Website
Wildfires	M	L		Fire Marshal/Park Service
Biological Hazards	M	H		Mosquito Control
Floods - Riverine	L	L		HMPC, FEMA, NCDC
Floods - Coastal	M/H	M		HMPC, FEMA, NCDC
Dam Failures	L	L		
H=High; M=Moderate; L=Low; N=No; N/A=Not Applicable, Unknown=Historical Data Unavailable; OEM=York County Office of Emergency Management; HMPC = York County Hazard Mitigation Planning Committee; NCDC=National Climatic Data Center; FEMA=Federal Emergency Management Agency; USGA=United States Geological Survey; MHA=Multi-Hazard Atlas				

Appendix E
Critical Facilities Inventory

Critical Facilities Inventory

The following coding was used for identification of critical facilities on the large format Multi-Hazard Mapping in Appendix F.

School	SC
Police	PO
Hospital	HO
Fire	FR
Airport	AI
Nursing Home	NH
Trailer Park	TP
Emergency Operations Center	EC
Day Care	DC
Clinics	CL
Pump Stations	PS
Communications	CO
E-911	E9
Government	GO
Sub Station	SB

Table E-1: City of Hampton Critical Facilities

Name	Code	Number
Station 6	FR	2
Station 9	FR	3
Station 10	FR	4
Station 8	FR	5
Station 7	FR	6
Station 2	FR	7
Station 3	FR	8
Station 1	FR	9
Station 5	FR	10
Station 4	FR	11
Fire Administration (City Hall)	FR	12
Fire Training Center	FR	13
Sentara Careplex	HO	3
Veterans Administration Center	HO	4
Dolittle	PO	2
Merrimac	PO	3
Police Headquarters	PO	4
LaSalle	PO	5
Police Field Office	PO	6
Coliseum Central	PO	7
Kecoughtan Court	PO	8
Briarfield	PO	9
Police	PO	54
Emmanuel Lutheran School	SC	5
Hampton Roads Convention Center/Hampton Coliseum	GO	1
Francis Asbury Elementary School	SC	8
Samuel P Langley Elementary School	SC	30
Machen Elementary School	SC	18
Thomas Nelson Community College	SC	36

Table E-1: City of Hampton Critical Facilities		
Name	**Code**	**Number**
New Horizon Regional Education Center	SC	23
Phillips Elementary School	SC	27
Willow Oaks Learning Foundation	SC	39
Booker Elementary School	SC	41
Gloria Dei Lutheran School	SC	9
Kecoughtan High School	SC	15
Syms Middle School	SC	34
Burbank Elementary School	SC	42
Hampton Christian Schools Inc	SC	10
Merrimack Elementary School	SC	21
Cooper Elementary School	SC	1
Bethel High School	SC	43
Kraft Elementary School	SC	16
Tyler Elementary School	SC	38
Eaton Middle School	SC	3
Barron Elementary School	SC	44
Cary Elementary School	SC	45
Jones Middle School	SC	14
Smith Elementary School	SC	31
Calvary Christian Academy	SC	47
Fox Hill Private School	SC	7
Davis Middle School	SC	2
North Hampton Early Learning Child Center	SC	25
Spratley Middle School	SC	32
Peninsula Primary School	SC	26
Forrest Elementary School	SC	6
Mary Peake – Y.H. Thomas Center	SC	20
Phoebus High School	SC	28
Aberdeen Elementary School	SC	48
Tucker Capps Elementary School	SC	37
Calvary Covenant School	SC	49
Jane Bryan Elementary School	SC	13
Moton Elementary School	SC	22
Mallory Elementary School	SC	19
Hampton High School	SC	11
Hampton University	SC	12
Tarrant Elementary School	SC	35
Bethel Christian School	SC	50
Robert E Lee Elementary School	SC	29
New Mount Olive Christian Academy	SC	24
Lindsay Middle School	SC	17
Bassette Elementary School	SC	51
St Mary Star Of The Sea School	SC	33
Armstrong Elementary School	SC	52
Emmanuel Grace Baptist Church	SC	4
Bradford Hall	SC	53
Wythe Elementary School	SC	40

Table E-2 City of Newport News Critical Facilities		
Name	**Code**	**Number**
Mary Immaculate	CL	2
Sentara Urgent Care	CL	3
Public Health Center	CL	4
Peninsula Medical Center	CL	7
Dr Cecil F Evans Office	CL	8
Doctor's Office	CL	9
Now Care Medical Center	CL	10
East End Health Center	CL	11
Whittaker Hosp Medical Office	CL	12
Stephen's Child Care	DC	2
Child Care	DC	3
Early Start Learning Center	DC	4
The Garden Of Children Ltd	DC	5
Holloman Child Care Center	DC	6
Teddy Bear	DC	7
Bright Horizons	DC	8
Children's World Inc	DC	9
Riverside Employee Child Care	DC	10
Unique Child Care	DC	11
Lollipop Lane	DC	12
Hampton Roads Montessori School	DC	13
Kinder Care	DC	14
While Away School	DC	15
While Away School	DC	16
United Child Care	DC	17
Bellwood Tender Care	DC	18
Warwick Kids Academy	DC	19
Youth Campus Day Care	DC	20
Ding Dong Kindergarden	DC	21
Tic-Toc Kindergarten	DC	22
Quality Nursery & Garden Center	DC	23
Jimmy's Nursery	DC	24
Emergency Operations Center	EC	2
Emergency Operations Center	EC	3
Station 5	FR	2
Fire Warehouse	FR	3
Station 9	FR	4
Station 4	FR	5
Station 6	FR	6
Station 3	FR	7
Station 8	FR	8
Station 10	FR	9
Station 2	FR	10
Station 7	FR	11
Station 1	FR	12
Fort Eustis Station	FR	13
Fort Eustis Station	FR	14
Fire Training Center	FR	15
Riverside Medical Center	HO	2
Mary Immaculate Hospital	HO	3
McDonald Army Hospital	HO	4
Woodside Hospital	HO	6
Serenity Inc	NH	2
Zion Baptist Convalescent	NH	3
Hilton Plaza Adult Home	NH	4
St Francis Nursing Center	NH	5
Newport News Nursing Center	NH	6
Newport Convalescent Center	NH	7
James River Convalescent Center	NH	8
James River Convalescent Center	NH	9

Table E-2 City of Newport News Critical Facilities		
Name	**Code**	**Number**
Because We Care Home for Adults	NH	10
Huntington Nursing Home	NH	11
Nursing Home	NH	12
Mdn Center	NH	13
Mennowood Retirement Community	NH	14
Spratley Housing	NH	15
Pump Station	PS	098
Pump Station	PS	099
Pump Station	PS	101
Pump Station	PS	102
Pump Station	PS	088
Pump Station	PS	089
Pump Station	PS	090
Pump Station	PS	091
Pump Station	PS	112
Pump Station	PS	
Pump Station	PS	
Pump Station	PS	115
Pump Station	PS	116
Pump Station	PS	117
Pump Station	PS	084
Pump Station	PS	085
Pump Station	PS	086
Pump Station	PS	087
Pump Station	PS	095
Pump Station	PS	096
Pump Station	PS	097
Pump Station	PS	118
Pump Station	PS	119
Pump Station	PS	120
Pump Station	PS	121
Pump Station	PS	122
Pump Station	PS	123
Pump Station	PS	124
Pump Station	PS	125
Pump Station	PS	126
Pump Station	PS	127
Pump Station	PS	
Pump Station	PS	129
Pump Station	PS	130
Pump Station	PS	131
Pump Station	PS	132
Pump Station	PS	133
Pump Station	PS	134
Pump Station	PS	135
Pump Station	PS	136
Pump Station	PS	137
Pump Station	PS	138
Pump Station	PS	139
Pump Station	PS	140
Pump Station	PS	141
Pump Station	PS	142
Pump Station	PS	143
Pump Station	PS	144
Pump Station	PS	145
Pump Station	PS	146
Pump Station	PS	147
Pump Station	PS	093
Pump Station	PS	094
Pump Station	PS	
Pump Station	PS	
Pump Station	PS	

Table E-2 City of Newport News Critical Facilities		
Name	**Code**	**Number**
Pump Station	PS	092
Pump Station	PS	
Pump Station	PS	108
Pump Station	PS	
Pump Station	PS	110
Pump Station	PS	
Pump Station	PS	
Pump Station	PS	148
Pump Station	PS	149
Pump Station	PS	150
Pump Station	PS	158
Pump Station	PS	159
Pump Station	PS	160
Pump Station	PS	161
Pump Station	PS	
Pump Station	PS	163
Pump Station	PS	164
Pump Station	PS	
Pump Station	PS	152
Pump Station	PS	153
Pump Station	PS	154
Pump Station	PS	155
Pump Station	PS	156
Pump Station	PS	171
Pump Station	PS	172
Pump Station	PS	173
Pump Station	PS	174
Pump Station	PS	182
Pump Station	PS	183
Pump Station	PS	184
Pump Station	PS	157
Pump Station	PS	165
Pump Station	PS	166
Pump Station	PS	167
Pump Station	PS	168
Pump Station	PS	169
Pump Station	PS	170
Pump Station	PS	185
Pump Station	PS	186
Pump Station	PS	187
Pump Station	PS	054
Pump Station	PS	055
Pump Station	PS	056
Pump Station	PS	057
Pump Station	PS	058
Pump Station	PS	059
Pump Station	PS	060
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Pump Station	PS	062
Pump Station	PS	063
Pump Station	PS	064
Pump Station	PS	065
Pump Station	PS	066
Pump Station	PS	067
Pump Station	PS	068
Pump Station	PS	069
Pump Station	PS	070
Pump Station	PS	071
Pump Station	PS	072
Pump Station	PS	073
Pump Station	PS	074
Pump Station	PS	075

Table E-2 City of Newport News Critical Facilities		
Name	**Code**	**Number**
Pump Station	PS	076
Pump Station	PS	077
Pump Station	PS	078
Pump Station	PS	079
Pump Station	PS	080
Pump Station	PS	081
Pump Station	PS	082
Pump Station	PS	188
Pump Station	PS	175
Pump Station	PS	083
Pump Station	PS	176
Pump Station	PS	177
Pump Station	PS	178
Pump Station	PS	179
Pump Station	PS	180
Pump Station	PS	181
Pump Station	PS	189
Pump Station	PS	190
Pump Station	PS	191
Pump Station	PS	192
Pump Station	PS	193
Pump Station	PS	194
Pump Station	PS	195
Pump Station	PS	196
Pump Station	PS	197
Pump Station	PS	198
Pump Station	PS	199
Pump Station	PS	200
Pump Station	PS	001
Pump Station	PS	002
Pump Station	PS	003
Pump Station	PS	004
Pump Station	PS	005
Pump Station	PS	006
Pump Station	PS	007
Pump Station	PS	008
Pump Station	PS	009
Pump Station	PS	011
Pump Station	PS	012
Pump Station	PS	013
Pump Station	PS	013
Pump Station	PS	014
Pump Station	PS	015
Pump Station	PS	015
Pump Station	PS	017
Pump Station	PS	018
Pump Station	PS	019
Pump Station	PS	020
Pump Station	PS	021
Pump Station	PS	022
Pump Station	PS	023
Pump Station	PS	024
Pump Station	PS	025
Pump Station	PS	026
Pump Station	PS	027
Pump Station	PS	028
Pump Station	PS	029
Pump Station	PS	030
Pump Station	PS	031
Pump Station	PS	032
Pump Station	PS	033
Pump Station	PS	034

Table E-2 City of Newport News Critical Facilities		
Name	**Code**	**Number**
Pump Station	PS	035
Pump Station	PS	036
Pump Station	PS	037
Pump Station	PS	038
Pump Station	PS	039
Pump Station	PS	040
Pump Station	PS	042
Pump Station	PS	043
Pump Station	PS	044
Pump Station	PS	045
Pump Station	PS	046
Pump Station	PS	047
Pump Station	PS	048
Pump Station	PS	049
Pump Station	PS	050
Pump Station	PS	051
Pump Station	PS	052
Pump Station	PS	053
Pump Station	PS	WWPFS
Pump Station	PS	WWPBO
Pump Station	PS	WWPAP
Pump Station	PS	WWPAJ
Pump Station	PS	WWPDV

Table E-3: City of Williamsburg Critical Facilities		
Name	**Code**	**Number**
City Municipal Building	GO	501
911 Center	E9	502
Fire & EMS Department	FR	503
Police Department	PO	504
Emergency Operations Center	EC	505
Fire Administration	FR	506
Williamsburg/James City County Courthouse	GO	507
Sentara Williamsburg Community Hospital	HO	508
Williamsburg Center Genesis Elder Care	NH	509
Micand Retirement Center	NH	510
Blayton Building Elderly Housing	AP	511
Matthew Whaley Elementary School & City Shelter	SC	512
James Blair Middle School	SC	513
Berkeley Middle School	SC	514
Walsingham Academy Upper School	SC	515
Walsingham Academy Lower School	SC	516
Communications Towers	CO	517
Power Sub Station	SB	544
Power Sub Station	SB	545
Power Sub Station	SB	546
Communication Tower	CO	547
Pump Station	PS	522
Pump Station	PS	523
Pump Station	PS	524
Pump Station	PS	525
Pump Station	PS	526
Pump Station	PS	527
Pump Station	PS	528
Pump Station	PS	529
Pump Station	PS	530
Pump Station	PS	531
Pump Station	PS	533
Pump Station	PS	534
Pump Station	PS	535
Pump Station	PS	536
Pump Station	PS	532

Table E-4: James City County Critical Facilities		
Name	**Code**	**Number**
Williamsburg Airport	AI	1
Emergency Operations Center	EC	1
Fire Station 2	FR	2
Fire Station 5	FR	3
Fire Station 3	FR	5
Fire Station 1	FR	1
Dispatch Center	FR	4
Law Enforcement Center	PO	1
Toano School	SC	14
Noney School	SC	15
Stonehouse Elementary School	SC	16
James Blair Middle School	SC	2
Berkeley Middle School	SC	3
Lafayette High School	SC	4
Jamestown High School	SC	5
D.J. Montague Elementary School	SC	7
Clara Byrd Baker Elementary School	SC	8
Rawls Byrd Elementary School	SC	9
Matthew Whaley Elementary School	SC	12
James River Elementary School	SC	13

Table E-5: York County Critical Facilities		
Name	**Code**	**Number**
Fire Station # 2	FR	53
Seaford Station Number 6	FR	62
Bruton Station Number 3	FR	65
Grafton Station Number 1	FR	114
Yorktown Station Number 4	FR	122
Tabb Station Number 2	FR	134
Skimino Station Number 5	FR	135
Yorktown Library	LB	221
Tabb Library	LB	222
Public Safety Building	GO	223
Solid Waste Management Center	GO	224
Environmental Services Building	GO	225
York/Poquoson Courthouse	GO	226
Finance Building	GO	227
Griffin-Yeates Center	GO	228
General Services	GO	229
Geo. Wash. Inn	PS	149
Bruton High Sch.	PS	150
Pinetree Road	PS	151
Royal Grant	PS	152
Hickory Hills	PS	153
Queenswood	PS	154
Penniman East	PS	155
Pierpoint Place	PS	156
Cedar Valley/Wal Mart	PS	157
Read Street	PS	158
Winders Pond	PS	159
Hornsbyville Road	PS	160
Cockletown Road	PS	161
Kings Villa	PS	162
Sommerville	PS	163
Oriana Road	PS	164
Landfill	PS	165
Hollywood	PS	166
Moss Avenue	PS	167
Ft. Eustis Boulevard	PS	168
Barcroft	PS	169
Route 17	PS	170
Don Juan	PS	171
Grafton Woods	PS	172
Pinehurst Vac	PS	173
Brandywine	PS	174
Mill Cove	PS	175
Scotch Toms	PS	176
Goosley Road	PS	177
Lodge Road	PS	178
York High	PS	179
Kiln Creek 1	PS	180
Kiln Creek 2	PS	181
Olde Port Cove	PS	182
Running Man 1	PS	183
Whispering Winds	PS	184
Marlbank Cove	PS	185
Lackey	PS	186
Yorkshire Downs	PS	187
Coventry	PS	188
Running Man 2	PS	189
Tabb Lakes	PS	190
York Co.Central	PS	191
Baptist Road	PS	192
Coburn Court	PS	193

Table E-5: York County Critical Facilities		
Name	**Code**	**Number**
Carys Chapel Rd.	PS	194
Lakes Of Dare	PS	195
Crestwoods	PS	196
Tidemill	PS	197
Seaford Vac. Sta	PS	198
Dandy Vac Sta.	PS	199
Cary's Chapel 2	PS	200
Calthop Neck Vac	PS	201
Belmount Apts	PS	202
Williamsburg Hosp.	PS	203
Schooner Blvd	PS	204
Corvette	PS	205
Jonadab Rd.	PS	206
Lindsay Landing	PS	207
Overlook Point	PS	208
Road Water Sta.	PS	209
Banbury Water	PS	210
Rochambeau Sta	PS	211
Lightfoot Sta.	PS	212
Dare Vacuum Sta.	PS	213
Yorktown Road	PS	214
Dare Heights	PS	215
Water Street	PS	216
Queenslake	PS	217
Kings Creek	PS	218
Coast Guard	PS	219
Colony Pines	PS	220
Tabb Middle School	SC	55
Mount Vernon Elementary School	SC	56
Grafton High/Middle School	SC	58
Yorktown Elementary School	SC	61
Yorktown Middle School	SC	63
Magruder Elementary School	SC	64
Bruton High School	SC	66
Coventry Elementary School	SC	77
Tabb High School	SC	80
York High School	SC	81
Tabb Elementary School	SC	83
Dare Elementary School	SC	131
Grafton Bethel Elementary School	SC	133
Waller Mill Elementary School	SC	136
Queens Lake Middle School	SC	137

Appendix F
Multi-Hazard Mapping
Large-Format Maps

Appendix G
Alternative Multi-Hazard Mitigation Actions

Alternative Multi-Hazard Mitigation Actions

PREVENTION: Preventive measures are designed to keep the problem from occurring or getting worse. Their objective is to ensure that future development is not exposed to damage and does not increase damage to other properties.

- ***Planning***
- ***Zoning***
- ***Open Space Preservation***
- ***Land Development Regulations***
  - ***Subdivision regulations***
  - ***Building Codes***
    - ***Fire-Wise Construction***
  - ***Floodplain development regulations***
  - ***Geologic Hazard Areas development regulations (for roads too!)***
- ***Storm Water Management***
- ***Fuels Management, Fire-Breaks***

EMERGENCY SERVICES measures protect people during and after a disaster. A good emergency services program addresses all hazards. Measures include:

- ***Warning*** (flooding, tornadoes, winter storms, fire)
  - NOAA Weather/All-Hazards Radio
  - Sirens
  - "Reverse 911" (Emergency Notification System)
- ***Emergency Response***
  - ***Evacuation & Sheltering***
  - ***Communications***
  - ***Emergency Planning***
    - Activating the EOC (emergency management)
    - Closing/Reversing streets/bridges (police or public works)
    - Shutting off power to threatened areas (utility company)
    - Holding/releasing children at school (school district)
    - Passing out sand and sandbags (public works)
    - Ordering an evacuation (mayor)
    - Opening emergency shelters (Red Cross)
    - Monitoring water levels (engineering)
    - Security and other protection measures (police)
- ***Critical Facilities Protection (Buildings or locations vital to the response and recovery effort, such as police/fire stations, hospitals, sewage treatment plants/lift stations, power substations)***
  - Buildings or locations that, if damaged, would create secondary disasters, such as hazardous materials facilities and nursing homes
  - Lifeline Utilities Protection
- ***Post-Disaster Mitigation***
  - Building Inspections
  - ID mitigation opportunities & funding before reconstruction

PROPERTY PROTECTION: Property protection measures are used to modify buildings subject to damage rather than to keep the hazard away. A community may find these to be inexpensive measures because often they are implemented by or cost-shared with property owners. Many of the measures do not affect the appearance or use of a building, which makes them particularly appropriate for historical sites and landmarks.

- ***Retrofitting/disaster proofing***
  - ***Floods***
    - Wet/Dry floodproofing (barriers, shields, backflow valves)
    - Relocation/Elevation
    - Acquisition
    - Retrofitting
  - ***High Winds/Tornadoes***
    - Safe Rooms
    - Securing roofs and foundations with fasteners and tie-downs
    - Strengthening garage doors and other large openings
  - ***Winter Storms***
    - Immediate snow/ice removal from roofs, tree limbs
    - “Living” snow fences
  - ***Geologic Hazards (Landslides, earthquakes, sinkholes)***
    - Anchoring, bracing, shear walls
    - Dewatering sites, agricultural practices
    - Catch basins
  - ***Drought***
    - Improve water supply (transport/storage/conservation)
    - Remove moisture competitive plants (Tamarisk/Salt Cedar)
    - Water Restrictions/Water Saver Sprinklers/Appliances
    - Grazing on CRP lands (no overgrazing-see Noxious Weeds)
    - Create incentives to consolidate/connect water services
    - Recycled wastewater on golf courses
  - ***Wildfire, Grassfires***
    - Replacing building components with fireproof materials
      - Roofing, screening
    - Create “Defensible Space”
    - Installing spark arrestors
    - Fuels Modification
  - ***Noxious Weeds/Insects***
    - Mowing
    - Spraying
    - Replacement planting
    - Stop overgrazing
    - Introduce natural predators

- ***Insurance***

NATURAL RESOURCE PROTECTION: Natural resource protection activities are generally aimed at preserving (or in some cases restoring) natural areas. In so doing, these activities enable the naturally beneficial functions of floodplains and watersheds to be better realized. These natural and beneficial floodplain functions include the following:

- storage of floodwaters
- absorption of flood energy
- reduction in flood scour
- infiltration that absorbs overland flood flow
- groundwater recharge
- removal/filtering of excess nutrients, pollutants, and sediments from floodwaters
- habitat for flora and fauna
- recreational and aesthetic opportunities

Methods of protecting natural resources include:

- ***Wetlands Protection***
- ***Riparian Area/Habitat Protection/Threatened-Endangered Species***
- ***Erosion & Sediment Control/Dune Protection***
- ***Best Management Practices***

  Best management practices ("BMPs") are measures that reduce nonpoint source pollutants that enter the waterways. Nonpoint source pollutants come from non-specific locations. Examples of nonpoint source pollutants are lawn fertilizers, pesticides, and other farm chemicals, animal wastes, oils from street surfaces and industrial areas and sediment from agriculture, construction, mining and forestry. These pollutants are washed off the ground's surface by stormwater and flushed into receiving storm sewers, ditches and streams. BMPs can be implemented during construction and as part of a project's design to permanently address nonpoint source pollutants. There are three general categories of BMPs:

  1. Avoidance: setting construction projects back from the stream.
  2. Reduction: Preventing runoff that conveys sediment and other water-borne pollutants, such as planting proper vegetation and conservation tillage.
  3. Cleanse: Stopping pollutants after they are en route to a stream, such as using grass drainageways that filter the water and retention and detention basins that let pollutants settle to the bottom before they are drained

- ***Dumping Regulations***
- ***Set-back regulations/buffers***
- ***Fuels Management***
- ***Water Use Restrictions***
- ***Landscape Management/Dune Management***
- ***Weather Modification***

STRUCTURAL PROJECTS have traditionally been used by communities to control flows and water surface elevations. Structural projects keep flood waters away from an area. They are usually designed by engineers and managed or maintained by public works staff. These measures are popular with many because they “stop” flooding problems. However, structural projects have several important shortcomings that need to be kept in mind when considering them for flood hazard mitigation:

- They are expensive, sometimes requiring capital bond issues and/or cost sharing with Federal agencies, such as the U.S. Army Corps of Engineers or the Natural Resources Conservation Service.

- They disturb the land and disrupt natural water flows, often destroying habitats.

- They are built to a certain flood protection level that can be exceeded by a larger flood, causing extensive damage.

- They can create a false sense of security when people protected by a structure believe that no flood can ever reach them.

- They require regular maintenance to ensure that they continue to provide their design protection level.

Structural measures include:

- ***Detention/Retention structures***
- ***Erosion and Sediment Control***
- ***Basins/Low-head Weirs***
- ***Channel Modifications***
- ***Culvert resizing/replacement/Maintenance***
- ***Levees and Floodwalls***
- ***Anchoring, grading, debris basins (for landslides)***
- ***Fencing (for snow, sand, wind)***
- ***Drainage System Maintenance***
- ***Reservoirs(for flood control, water storage, recreation, agriculture)***
- ***Diversions***
- ***Storm Sewers***

PUBLIC INFORMATION: A successful hazard mitigation program involves both the public and private sectors. Public information activities advise property owners, renters, businesses, and local officials about hazards and ways to protect people and property from these hazards. These activities can motivate people to take protection

- ***Hazard Maps and Data***
- ***Outreach Projects*** (mailings, media, web, speakers bureau, displays)
- ***Library Resources***
- ***Real Estate Disclosure***
- ***Environmental Education***

Technical Assistance **Health & Safety Maintenance (clean-up per hazard)**

Appendix H
Criteria for Selecting Mitigation Measures

Criteria for Selecting Mitigation Measures

1. STAPLE

Social: Does the measure treat people fairly? (different groups, different generations)

Technical: Will it work? (Does it solve the problem? Is it feasible?)

Administrative: Do you have the capacity to implement & manage project?

Political: Who are the stakeholders? Did they get to participate? Is there public s support? Is political leadership willing to support?

Legal: Does your organization have the authority to implement? Is it legal? Are there liability implications?

Economic: Is it cost-beneficial? Is there funding? Does it contribute to the local economy or economic development?

Environmental: Does it comply with Environmental regulations?

2. **SUSTAINABLE DISASTER RECOVERY**

Quality of Life

Social Equity

Hazard Mitigation

Economic Development

Environmental Protection/Enhancement

Community Participation

3. SMART GROWTH PRINCIPLES

Infill versus Sprawl

Efficient Use of Land Resources

Full Use of Urban Resources

Mixed Uses of Land

Transportation Options

Detailed, Human-Scale Design

4. OTHER

Does measure address area with highest risk?

Does measure protect …

- The largest # of people exposed to risk?
- The largest # of buildings?
- The largest # of jobs?
- The largest tax income?
- The largest average annual loss potential?
- The area impacted most frequently?
- Critical Infrastructure (access, power, water, gas, telecommunications)

Timing of Available funding

Visibility of Project

Community Credibility

Appendix I
Public Meeting Notices and Community Resolutions of Adoption

From the *Daily Press*, 2/13/05

MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

Hampton, Newport News, Williamsburg, James City County, York County

The purpose is to solicit input from the public in the development of this plan. These jurisdictions are developing a draft Natural Hazard Mitigation Plan in order both to reduce the impact of future disasters and also meet Federal Requirements.

Jurisdiction Planning Groups and AMEC Earth and Environmental will be at the following locations to discuss the planning process and receive public input:

February 16, 2005, 7:00 P.M. - 8:00 P.M.
101 F Mounts Bay Building F, James City County

February 17, 2005 7:00 P.M. - 8:00 P.M.
York Hall, East Room, Yorktown, York County

February 28, 2005 7:00 P.M. - 8:00 P.M.
Sandy Bottom Nature Park, 1255 Big Bethel Rd, Hampton

Citizens from participating jurisdictions can attend any of the three meetings listed. For further information please contact your local Emergency Management Office or Planning Department.

PUBLIC MEETINGS FOR NATURAL HAZARD MITIGATION PLAN

The Peninsula Hazard Mitigation Planning Committee, comprising of the City of Newport News, City of Hampton, City of Williamsburg, York County and James City County are sponsoring the development of **a regional comprehensive natural hazard mitigation plan** to better marshal County and Community resources in **addressing potential hazards before they occur**, and, to **maintain eligibility for mitigation funding from the Federal Emergency Management Agency** (FEMA). Within the County and the City, **this plan will help lower the cost of flood insurance.**

We'd like **YOUR feedback** regarding this important document, which must be approved by each City Council, the County Board of Supervisors, the State and FEMA this fall.

The plan is being developed by a Hazard Mitigation Planning Committee (HMPC) with input from County and City agencies, including each incorporated community, Special Districts (e.g., reclamation, recreation, fire, community college), regional flood and state and federal agencies (e.g., FEMA, USACE, NWS).

Before the recommendations and the first draft plan are developed, the HMPC would like to present our research and findings regarding the natural hazards posing threats to the Peninsula Area, and our current ability to counter those threats. Your comments and ideas are invited and are welcome at the upcoming public meetings, scheduled as follows:

Wednesday, February 16, 2005
James City County Government Complex
Board Room
101-F Mounts Bay Road
Williamsburg, VA 23185
7:00 p.m. - 8:30 p.m.

The program will include time for comments, questions and answers after a summary of each planning step is explained.

The deadline for public comment will be following the third phase this spring when the draft plan will be ready for review. Your feedback will be incorporated into the final version of the plan which will then reviewed by the Virginia Department of Emergency Management and FEMA, Region III. Upon approval, the plan will be presented to the County Board of Supervisors, and each incorporated community.

From the *Daily Press*, 6/19/05

MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

Hampton, Newport News, Williamsburg, James City County, York County

The purpose if to solicit input from the public in the development of this plan. These jurisdictions are developing a draft Natural Hazard Mitigation Plan in order both to reduce the impact of future disasters and also meet Federal Requirements.

Jurisdiction Planning Groups and AMEC Earth and Environmental will be at the following locations to discuss the planning processing and receive public input:

June 22, 2005 6:30 pm-7:30 pm

Pearl Bailey Library 2510 Wickham Avenue, Newport News

June 23, 2005 7:00 pm-8:00 pm

Kenny Wallace Neighborhood Resource Center 2315 Victoria Blvd, Hampton

June 27, 2005 7:00 pm-8:00 pm

Governement Center Building F 101 Mounts Bay Road, James City County

Citizens from participating jurisdictions can attend any of the three meetings listed. For further information please contact your local Emergency Management Office or Planning Department.

From the *Daily Press*, 10/30/05

MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

Hampton, Newport News, Williamsburg, James City County, York County

The purpose if to solicit input from the public in the development of this plan. These jurisdictions have developed a draft Natural Hazard Mitigation Plan in order both to reduce the impact of future disasters and also meet Federal Requirements. Jurisdiction Planning Groups and AMEC Earth and Environmental will be at the following locations to discuss the planning processing and receive final public input:

Tuesday November 1, 2005 7:00-8:00 pm
Quarterpath Recreation Center 202 Quarterpath Road, Williamsburg

Wednesday November 2, 2005 6:00-7:00 pm
Tabb Library, 100 Long Green Blvd, York County

Thursday November 3, 2005 7:00-8:00 pm
Pearl Bailey Library, 2510 Wickham Avenue, Newport News

Citizens from participating jurisdictions can attend any of the three meetings listed. For further information please contact your local Emergency Management Office or Planning Department.

Hampton
[insert here]

Newport News
[insert here]

Williamsburg
[insert here]

James City County
[insert here]

York County
[insert here]

Appendix J
Acronyms Used in this Plan

Acronyms Used in this Plan

AMEC	AMEC Earth & Environmental, Inc.
ARB	Architectural Review Board
BMP	Best Management Practice(s)
CDC	Centers for Disease Control and Prevention
CERT	Community Emergency Response Team
CIP	Capital Improvements Program (York County)
CoBRA	Coastal Barrier Resource Act
CPTED	Crime Prevention through Environmental Design
CRS	Community Rating System of the National Flood Insurance Program
CZMA	Coastal Zone Management Act
DCR or VaDCR	Virginia Department of Conservation and Recreation
DMA 2000	Disaster Mitigation Act of 2000
DRC	Development Review Committee
DRU	Disaster Resistant University
EAS	Emergency Alert System
EMS	Emergency Medical Services
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPRI	Electric Power Research Institute
FAP	Flood Assistance Program (Newport News)
FAQ	Frequently Asked Question(s)
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
GIS	Geographic Information System
HAZUS	Hazards U.S. – Multi Hazard (software package)
HI	Heat Index
HMGP	Hazard Mitigation Grant Program
HMPC	Hazard Mitigation Planning Committee
HREMC	Hampton Roads Emergency Management Committee
HRPDC	Hampton Roads Planning District Commission
IBC	International Building Code
ICC	Increased Cost of Compliance
JCSA	James City Service Authority
MM or MMI	Modified Mercalli Intensity Scale
MRC	Medical Reserve Corps
MSA	Metropolitan Statistical Area
NCDC	National Climatic Data Center
NEIDS	Neighborhood Emergency Information Distribution System
NFIP	National Flood Insurance Program
NGDC	National Geophysical Data Center
NGVD	National Geodetic Vertical Datum

NOAA	National Oceanic and Atmospheric Association
NPS	National Park Service
NWS	National Weather Service
PDI	Palmer Drought Index
PDM	Pre-Disaster Mitigation
PSA	Primary Service Area (James City County)
REMTAC	Regional Emergency Management Technical Advisory Committee
RMA	Resource Management Area
RPA	Resource Protection Area
SAC	Stormwater Advisory Committee (York County)
SEAS	Shoreline Erosion Advisory Service
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
VCMP	Virginia Clean Marina Program
VDEM	Virginia Department of Emergency Management
VDH	Virginia Department of Health
VDOF	Virginia Department of Forestry
VDOT	Virginia Department of Transportation
VIPS	Volunteers in Police Service
VMRC	Virginia Marine Resources Commission
VPPSA	Virginia Peninsula's Public Service Authority
VS&WCB	Virginia Soil and Water Conservation Board
VTSO	Virginia Tech Seismological Observatory
VUSBC	Virginia Uniform Statewide Building Code
WNV	West Nile Virus

Appendix K
Public Comments and Response to Comments Memos

Comments and Responses to the Draft Natural Hazard Mitigation Plan, dated Feb 1, 2005
Draft #1

Reviewer: Jim Murphy
Agency: City of Williamsburg

1. ***Page 81, Capability Matrix Table. Denote "0" for Number of Flood-Prone Buildings and Number of Repetitive Losses.***

Response: Corrected

Reviewer: Emily Seward
Agency: City of Newport News

1. Page 67, ***Framework for the Future,*** **4th bullet. Add "Port Warwick" after Oyster Point.**

Response: Corrected

2. Page 68, Stormwater Program and Fees, 3rd paragraph, last sentence. Change to "The City's Department of Planning and Department of Development . . . ."

Response: Corrected

3. Page 70, Emergency Preparedness, 4th paragraph, 3rd sentence. Change phone number to "269-2910."

Response: Corrected

4. Page 70, Other Mitigation Activities, 3rd paragraph, 2nd sentence. Change to "Department of Development."

Response: Corrected

5. Page 71, Other Mitigation Activities, 5th paragraph, 5th sentence. Change to ". . . the southeast community (flood-prone) part of the City . . . ."

Response: Corrected, but left out "part" because it is redundant.

Reviewer: Jim Redick
Agency: City of Hampton

1. Page 52, Section 5.1.6, "…the planning team developed a local capability assessment for the City of Hampton." We did?? Have the Emergency Management Local Capability Assessment Reports (LCAR) been reviewed?

Response: AMEC conducted telephone and in-person interviews with planning team members to develop the capability assessment. LCAR were not reviewed, but have been requested from the City. Pertinent information from those reports will be incorporated as it relates to mitigation capability, as differentiated from emergency management capability.

2. Page 52 – Recommends we be Storm Ready. We became Storm Ready in 2004.

Response: Text removed.

3. Page 52, Capability Matrix. It would be much more informative to have the materials dated and the source of the information. For instance, Hampton has a Comprehensive Plan. What is the date on the plan? Who houses it?

Response: The matrix is intended to provide information at a glance. The date and department for the Comprehensive Plan has been added to the descriptive information below the table.

4. Page 52, Capability Matrix**. **"Effective Flood Insurance Rate Map Date" – why is this 1995 when data earlier in the report was 1988?

Response: The correct effective FIRM date for Hampton is 7-3-95, according to FEMA's Community Status Book.

5. Page 52, Capability Matrix**. **"Number of floodprone buildings" – is this info available from the info in Table 5.1.5a?

Response: Hampton's GIS staff have provided an estimate of floodprone buildings.

6. Page 52, Capability Matrix**. **"Number of NFIP policies = 9,792" – as of when? Info is time sensitive.

Response: Date information was added.

7. Page 53, Capability Matrix**. **Since this is a public plan, acronyms should be explained.

Response: Document will include an Appendix explaining acronyms.

8. Page 53, Capability Matrix. "-other? (e.g., cable override)" – remove CERT.

Response: Corrected.

9. Page 53, Capability Matrix. Please explain what "not fully" means in regards to the protection of critical facilities.

Response: Changed to "Not all facilities fully protected."

10. Page 53, Capability Matrix. "Natural Resources Inventory" – what does this include?

Response: A Natural Resources Inventory might include detailed data on (for example) habitats (threatened/endangered/otherwise), planting zones, wetland functions, watershed protection areas, areas of high soil erodibility, areas with high water tables, areas with shrink/swell soils or areas with steep slopes. GIS staff for Hampton indicated that the City did not maintain databases with inventory of this type.

11. Page 53, Capability Matrix. Please provide more data regarding the last 7 items on the capability matrix.

Response: Additional notations were added to 6 of the 7; however, since a Natural Resources Inventory was not identified, additional information was not available.

12. Page 54, section Guiding Community Documents. There is no Comprehensive Plan 2020. Remove that from the title and add a bullet that states "The City is currently working to adopt a new ten year plan, the City of Hampton Community Plan."

Response: Corrected. The final bullet was amended as requested.

13. Page 54 – Zoning & Development Standards. "The Department of Codes Compliance enforced requirements for 'substantially damaged' homes after Hurricane Isabel, but the process was exceedingly difficult and some difficult decisions had to be made."

Response: Amended as requested.

14. Page 55, the earliest that the 2003 VUSBC would be adopted is the Fall of 2005 (that's assuming that everything goes fine in the process); in each locality's section, we state April, 2005 as the effective date.

Response: Corrected.

15. Page 55, Public Education – "The City's Department of Public Works…" – there is also a Codes Academy, and info is also disseminated via the City's Neighborhood College Leadership Institute.

Response: Corrected.

16. Page 55, Emergency Preparedness - "EAS is now routinely used for…" – remove "now routinely."

Response: Corrected.

17. Page 56, Storm Ready - Should read "As of February 2005, the National Weather Service… (provided this is still accurate).

Response: Corrected.

18. Page 56, Evacuation Plan - Paragraph should start by saying: "The Virginia Department of Transportation's Phase 1 and Phase 2 evacuation routes are shown and discussed online at… . They are also available in the local telephone directories. The City emergency management and other City officials are re-examining…"

Response: Corrected.

19. Page 56, Hampton Citizen Corps and CERT Program. Remove "and CERT Program" in the paragraph title.

Response: Corrected.

20. Page 56. Replace "USA Freedom Corps" with "Virginia Corps."

Response: Corrected.

21. Page 56. "Hampton's umbrella program…" should read "Hampton's Citizen Corps includes 3 core programs: Neighborhood Watch, Volunteers in Police Service (VIPS), and Community Emergency Response Team (CERT). Medical Reserve Corps (MRC) is under development."

Response: Corrected.

22. "CERT helps communities respond…" If you are going to discuss CERT, you need to do the same for the other programs.

Response: Disagree. Added a clarification that CERT is the "core program most relevant to hazard mitigation." The other programs do not appear to have capability related to hazard mitigation.

23. Page 56. The document mentions that all substations are out of the flood zone. I am not sure of every location but the one at Fox Hill and Old Buckroe is definitely in the A7 elevation 9 zone.

Response: Corrected.

*24. **"The homes have not been elevated and the grants have not been approved or denied at the time this plan was prepared." Not true. Although the first home elevation project is still in review at the Federal level, the second project was denied.***

Response: Corrected.

Reviewer: Judi Riutort
Agency: York County

1. Page 94, Section 5.4.6, 4th paragraph. Change "they have" to "it has."

Response: Corrected.

2. Page 95, Capability Matrix. Change CRS Rating from "None" to "Conditional approval – Class 9."

Response: Corrected.

3. Page 95, Capability Matrix. Change Hazard Mitigation Plan from "Yes, Surry Siren System" to "In Process."

Response: Corrected.

4. Page 95, Capability Matrix. Add "Route alerting plans and an automated system in the planning phase" for Emergency Notification. Add "cable override and agreement with radio station" for Other.

Response: Corrected.

5. Page 95, Capability Matrix. Change "not fully" to "partially" for Critical Facilities Protected.

Response: Corrected.

6. Page 95, Form of Governance. First sentence, change "York County" to "elected." Second sentence, change to ". . . elected annually by the five member board", and delete "to serve for one year." Third sentence, change "serves" to "serve".

Response: Corrected except for last change. "Board" is singular.

7. Pages 95 and 96, Guiding Community Documents. First sentence, change "their" to "its". Third sentence, change "City" to "County" and delete "ordinances" after "zoning". Final sentence, change "its'" to "its".

Response: Corrected.

8. Page 96, Comprehensive Plan. Change title to "Charting the Course to 2015, the County of York Comprehensive Plan". 2nd sentence, do not capitalize "Comprehensive Plan". 7th bullet, change to "Potential Mixed Use areas identified along Route 17 and in the area of the interstate 64 Camp Peary interchange." Final bullet, do not capitalize comprehensive plan and add "update for 2025."

Response: Corrected.

9. Page 96, Zoning and Development Standards. First bullet, write out RPA/RMA, and add "for Chesapeake Bay protection." 2nd full paragraph, add "the Department of" before Environmental and Development Services.

Response: Corrected.

10. Page 97, Building Codes. First paragraph, take out "In January of 2005". 2nd paragraph, 1st sentence, clarify local government department name.

Response: The "January of 2005" phrase has been left in the text to clarify the building codes at the time of the report. The codes will change soon, and we feel that the information should be dated for clarity. The Building Codes section was removed to the State Capabilities section and the pertinent, specific agency for each community is, therefore, not named.

11. Page 97, Stormwater Program. First paragraph, first sentence, clarify the department's name. Second paragraph, first sentence, change to ". . . when the County receives complaints/inquiries about drainage problems, staff complete a study to determine if there are easements, if it is the County's responsibility to correct the problems, and make recommendations for addressing the issue that can include developing a project plan and adding it to the Capital Improvement Plan list and ranking it with . . . ." Delete sentence beginning, "The County Board of Supervisors . . . ," and combine with previous sentence.

Response: Corrected, with some editorial changes to shorten sentence.

12. Page 98, Stormwater Program. Third paragraph. Change "stormwater" to "storm water".

Response: Industry standard is "stormwater" and York County documents and committee names also refer to "stormwater."

13. Page 98, Stormwater Program. Additional paragraph. Text provided to append to this section.

Response: Text appended as requested.

14. Page 98, Public Education, first paragraph. Capitalize "Website". Append to the end, "The County publishes a quarterly newsletter (CITIZEN NEWS), which is mailed to every household. The County maintains a government access TV channel using Cox Cable.

Response: Disagree with capitalization. Other corrections made as requested.

15. Page 98. Public Education, second paragraph. Text provided to append to this section.

Response: Text appended as requested.

16. Page 98. Public Education, third paragraph. Add "Department of . . ." to the first sentence.

Response: Corrected.

17. Page 98, Emergency Preparedness. Append introductory paragraphs on Dept. of Fire and Life Safety. Include sentence, "The following list some of the important considerations in an emergency management program: . . ."

Response: Text appended as requested. The sentence was modified to reflect the mitigation focus of the capability assessment.

18. Page 98, Emergency Preparedness. Add, "York County coordinates with Newport News Waterworks and Williamsburg Water to provide door-to-door notification in the inundation zone for their dams located in York County."

Response: Text appended as requested.

19. Page 98, Emergency Preparedness. Add radio station name in parentheses (WXGM 99.1 FM), and replace phrase beginning ". . . previous arrangements with large area . . ." with the following, "the media became

overwhelmed and summarized emergency information for the smaller media markets leaving out details residents needed for recovery activities."

<u>Response:</u> Text appended as requested.

20. Page 98, Emergency Preparedness, Evacuation. Reword first sentence. Add "across the Coleman Bridge" to the last sentence.

<u>Response:</u> First sentence was moved with the bulk of the evacuation text to the State capabilities section. Text appended as requested.

21. Page 99, Emergency Preparedness, Special Needs Program. Rewrite paragraph as indicated, and add paragraph on CERT as provided.

<u>Response:</u> Text rewritten as requested.

22. Page 99, Emergency Preparedness, Other Mitigation Activities. Add sentence about Hazard Mitigation Grant Program funding in 2000 for $7,937 to install impact resistant glazing in windows of EOC. 1st paragraph, 1st sentence, add "the" before "substantial damage regulations. . . ." 2nd paragraph, last sentence, append, "This brings it above the 100-year flood elevation."

<u>Response:</u> Text rewritten as requested with slight change to last sentence.

23. Page 99, Emergency Preparedness, Other Mitigation Activities. Append text provided regarding Household Chemical Disposal program, generator back-up power, and Capital Improvements Program.

<u>Response:</u> Household Chemical Disposal program and generator back-up power text appended. Capital Improvements Program projects are moved to recommended mitigation actions.

Comments and Responses to the Draft Natural Hazard Mitigation Plan, dated June 7, 2005
Draft #2

Reviewer: Jim Murphy
Agency: City of Williamsburg

1. ***Page 139, Action Item #1. Reword Schedule to denote "within 3 years of plan adoption."***
   Response: Revised.

2. ***Page 142, Action Item #4. Cost Estimate of $25,000 per shelter is acceptable. Shelters will be ARC certified.***
   Response: Amended to include new information.

3. ***Page 143, Action Item #5. Reduce cost to $100,000, and note that existing hiking/biking trails will be widened and improved to provide firefighting access. Increase implementation to 5 years from plan adoption.***
   Response: Revised.

4. ***Page 145, Action Item #7. Reword to indicate that this is a continuation of ongoing programs in both Williamsburg and Colonial Williamsburg. Remove references to history of drainage system.***
   Response: Revised.

5. ***Page 145, Action Item #8. Remove this action item, as it does not accurately reflect existing conditions.***
   Response: Revised.

6. ***Page 145, Action Item #8. Add Action Item for Colonial Williamsburg's Annual Tree Maintenance Program.***
   Response: Action Item appended.

7. ***Page 146, Action Item #9. Add Action Item for Disaster Resistant University planning assistance to the College of William and Mary.***
   Response: Action Item appended.

Reviewer: Cindy Greczek
Agency: Colonial Williamsburg Foundation

8. ***Page 145, Action Item #7. Revise last sentence of Issue/Background to read: "Colonial Williamsburg Foundation directs performs an annual storm drain maintenance program in the Historic Area, under the direction of the City of Williamsburg."***
   Response: Revised.

9. ***Page 145, Action Item #7. Revise potential funding to indicate that* costs for projects in the Historic Area are shared with the Colonial Williamsburg Foundation.**
   Response: Revised.

Reviewer: Jim Redick
Agency: City of Hampton

10. **Pg 4, 2.0 Community Profile – Population, 2nd paragraph: "Recent population projections…" "Recent" should be defined. Is it 2004? 2000? 1990? How recent is it?**
    Response: A wholesale revision of this section better explains recent projections and provides some more interpretation.

11. **Pg. 4, 2,1 City of Hampton – If you're going to list all of the other installations, Langley AFB is also in the City of Hampton.**

Response: A wholesale revision of this section provides a better summary of the City's history, and includes a brief discussion of Langley's Field's place in aeronautical history.

12. **Pg. 9, Step 1: Get Organized, 3rd sentence should read: "With the Committee's commitment to participate, the first step… (remove AMEC). The Peninsula is the lead organization, and the customer. AMEC is the contractor.**
    Response: Revised; also removed prepositional phrase beginning "with the Committee's commitment . . .", as the phrase states the obvious.

13. **Pg. 9, Step 2: Plan for Public Engagement – Hampton's web address should read http://www.hampotn.gov/eoc. Also, confirm with Newport News, but I believe "The Project Manager's Office" is the Office of Emergency Management, which is reflected in the previous paragraph, Step 1.**
    Response: Revised.

14. **Pg. 10, Relationship with Other Community… "The Committee identified a variety of comprehensive planning mechanisms such as land use and master plans, emergency response and mitigation plans, and municipal ordinances and building codes…" Too many "and's."**
    Response: Revised.

15. **Pg. 10, bottom box – "2003 Hurricane Isabel Damage Survey Report (DSR)" What is a DSR? Should this read Damage Assessment Report?**
    Response: Revised.

16. **Pg. 11 – The page states this template would be used for the community assessments, etc, but when you get to them, they don't.**
    Response: The section was substantially revised and the template was put in a narrative form that more accurately represents the information provided in Section 5.

17. **Pg. 11, Critical Facility Identification – Where did you get this definition? It may not be consistent with definitions used by utility companies or other entities.**
    Response: This definition of critical facilities is generally recognized by FEMA for the purposes of mitigation planning. The phrase, "For the purposes of mitigation planning," was appended to the definition for clarity.

18. **Pg. 15, 4.1 Hazard Identification – Still not sure why Biological Hazards/Epidemics is in a "natural" hazard mitigation plan.**
    Response: Hazards are typically designated as "natural" or "manmade". While there are some biological hazards that may fall in the manmade category (eg, chemical weaponry), there are others that fall in the natural category (eg, West Nile Virus). WNV is caused by a natural process, not through fault of man.

19. **Pg. 15, "There have been 34 Presidential disaster declarations in Virginia since 1969 (Table 4.1)" – Since this is a Peninsula plan, how many of these declarations affected the Peninsula?**
    Response: Revised w/updated information and declaration numbers. Included column regarding Peninsula impacts. Attempted to gather additional information on early VA declarations.

20. **Pg. 16, 4.1.1 Earthquakes – Why start with earthquakes? Why not highest probability to least, or alphabetical order? Also, each jurisdiction has differing vulnerabilities, risk, etc. Each jurisdiction should have their own rating of each hazard in their jurisdiction-specific tab of the plan.**
    Response: Revised. Hazards re-ordered roughly according to vulnerability.

21. **Pg. 17, top graphic – what does this mean?**
    Response: Revised. Earthquake graphics were revised following an interview with Bill Sammler, NWS.

22. **Pg. 17, last paragraph - "Historical data is supportive of the moderate earthquake risk assessment for Virginia and the Peninsula area." Define moderate in relation to risk analysis. Also, the end of the paragraph refers to map C-1. Where is it?**

<u>Response:</u> Revised. Earthquake graphics and text were revised following an interview with Bill Sammler, NWS.

23. **Page 18/19, Table 4.1.1 – Earthquake info for PA, TN, WV, and MD – How does this impact the Peninsula?**
<u>Response:</u> Revised. Earthquake graphics and text were revised following an interview with Bill Sammler, NWS.

24. **Pg. 20 – "Yorktown has taken a proactive stance…" So have other jurisdictions.**
<u>Response:</u> Revised.

25. **Pg. 21 – Figure 4.1.3a – Who is UVCD?**
<u>Response:</u> Revised.

26. **Pg. 22 – Table 4.1.3 – There are 12 lightning occurrences listed, but the previous paragraph on page 21 says 10.**
<u>Response:</u> Revised. Thunderstorm and lighting graphics and text were revised following an interview with Bill Sammler, NWS.

27. **Pg. 23 – second to last paragraph – "There have been numerous (add "urban and") flash floods…**
<u>Response:</u> Revised.

28. **Pg. 24 – sentence above Table 4.1.6a – For further information regarding community-specific dams, please contact the office of the local emergency services coordinator??**
<u>Response:</u> Revised.

29. **Pg. 28 – first paragraph refers to Map A-2. Where is map A-2?**
<u>Response:</u> Revised.

30. **Pg. 28 – Table 4.1.8b – Why was a TS in 1961 unnamed?**
<u>Response:</u> Revised.

31. **Pg. 33, 4.1.11, second paragraph – Direct sunlight dries vegetative fuels, etc… "conductive" should be "conducive"**
<u>Response:</u> Revised.

32. **Pg. 43 – Department of Housing and Community Development – this title should be in bold text.**
<u>Response:</u> Revised.

33. **Pg. 46 – Military Installations – Should not put a negative light on installations.**
<u>Response:</u> Revised language and relocated this paragraph to indicate that military installations liaisons were invited to participate in the planning meetings.

34. **Pg. 47, section 5.1.1 FEMA Flood Insurance Study: Since this is a public document, "100- and 500- year flood" should be defined.**
<u>Response:</u> Revised.

35. **Pg. 48, 5.1.2 Hurricanes – City of Hampton, last two paragraphs – was this in Hampton? If this is a jurisdiction specific section, then get down to specifics rather than the global picture. Why was flood insurance policy data removed in this draft? It would be the basis for showing the benefit of CRS!**
<u>Response:</u> The community specific discussion of hurricanes was significantly rewritten using best available data. If additional data regarding damages, injuries, and other specific numbers are available from the City, the City must provide it to AMEC in order for it to be included. Flood insurance policy data regarding the benefits of CRS was replaced in Hampton's Action Item #1.

36. **Pg. 49, 5.1.3, Tornados, first paragraph – "Denis" should be "Dennis"**

Response: Revised.

37. **Pg. 50, 5.1.5, Vulnerability Assessment – Hurricanes, flooding, tornado, and wildfires have already been discussed. Now we are getting to the assessment?**
Response: The hazard ID and the vulnerability assessment are separate. See introduction to Section 4 for a summary of the two sections. However, Section 5.1.5 and the applicable sections for other communities have been rewritten to smooth the transition.

38. **Pg. 50, Table 5.1.5a – What is "other?" Is this government facilities? What is "No values?" Is this vacant land? Need to be defined.**
Response: Since this data was provided by Hampton, the definitions were requested from Allan Lambert on 9/21/05, and Libby Griebel on 9/32/05. Table revised to be as specific as possible, given known parameters in conjunction with guidance from Mr. Lambert and Ms. Griebel.

39. **Pg. 51, Repetitive Loss Areas – Needs to be Hampton-specific, not global.**
Response: Revised to include additional details on Hampton's repetitive loss data. The following sentence was added, "City planners have identified specific areas of the City that contain large numbers of repetitive losses; however, in order to protect the privacy of those policyholders, that information cannot be shared in this plan."

40. **Pg. 52, Hurricane Vulnerability Analysis – It should be emphasized here that this does NOT depict flooding damage. Table 5.1.5b – "Total $ Value Exposed Structures" – from wind only**
Response: Revised table title and preceding paragraph.

41. **Pg. 53, Critical Facilities Analysis, second paragraph: The inventory of critical facilities for the City of Hampton (not Newport News).**
Response: Revised.

42. **Pg. 53, Table 5.1.5e: Text should all be uniform – some are all caps, some are not; Change 7-11 to Police Substation; and Remove Buckroe Skills Center.**
Response: Revised for all communities and the appendices.

43. ***Pg. 54, 5.1.6 – "…the planning developed a local capability assessment for the City of Hampton." This terminology could be confused with an LCAR (Local Capability Assessment Report).***
Response: Revised to read, ". . . assessed Hampton's existing mitigation capabilities."

44. ***Pg. 54, Capability Matrix: Hampton does have a Floodplain Manager, Fred Whitley.***
Response: The key word in the matrix is "Certified." The Association of State Floodplain Managers has established a national program for professional certification of floodplain managers. Those candidates who pass the test and meet certain minimum professional qualifications can become Certified Floodplain Managers. Mr. Whitley is not listed on the official list of CFMs for Virginia at www.floods.org.

45. ***Pg. 55, Capability Matrix, Local Emergency Operations Plan: Why is CERT mentioned here?***
Response: Revised. CERT was removed from EOP and placed under Public Information Program.

46. ***Pg. 55, Hazard Mitigation Plan – should read "Pending"?***
Response: Revised.

47. ***Pg. 55, Form of Governance – Council–Manager Form of Government***
Response: Revised. A sentence was added to the beginning clearly indicating that Hampton has a Council-Manager Form of Government. The title of the section cannot be changed because the five jurisdictions covered by the plan do not all have Council-Manager forms.

48. ***Pg. 56, bullet beginning with "The City is currently working to adopt a new ten year plan, the City of Hampton Community Plan. Remove sentence beginning with "The new plan will be based… replace it with "This plan will be adopted in the Fall of 2005."***

Response: Revised.

49. ***Pg. 56, last sentence before Stormwater Program and Fees: "The Emergency Management" should read "The Office of Emergency Management"***
Response: Revised.

50. ***Pg. 57, Public Education: website should read http://www.hampton.gov***
Response: Revised.

51. ***Pg. 57, Public Education, second paragraph, 3-1-1 information: Residents (add within the City limits) dial 3-1-1… 3-1-1 can also be accessed by residents with cell phones, or who are outside of the City limits by calling 727-8311.***
Response: Revised.

52. ***Pg. 57, Public Education: Emergency Preparedness information is also disseminated through the City PIO's eNews, free e-mail briefs about what's happening in Hampton, and the City's local cable channel, Channel 47.***
Response: Revised.

53. ***Pg. 58, Other Mitigation Activities, second paragraph: At the time of this report, the project is in the procurement phase.***
Response: Revised.

54. ***Pg. 111, 6.0, second paragraph – "Each HMPC member was provided (remove with) a written…"***
Response: Revised.

55. ***Potential Funding: AMEC includes the funding sources that we provide, or states HMGP 75%; City of Hampton 25%. The expectation was that AMEC would let us know what other sources were available.***
Response: Additional *potential* funding sources have been identified and added.

56. ***Schedule: Since these are recommended, not required actions, I think it would be appropriate to remove the Schedule pieces on all action items.***
Response: FEMA guidance and the review crosswalks require that a timeframe for implementation be included. In Section 5.5, 1st paragraph, 2nd sentence, we added the following phrase to address this comment: "the schedules and cost estimates are not binding and do not imply that the community must complete each action."

57. ***Pg. 120, Responsible Party – "Hampton's NFIP administrator" – We don't have an NFIP administrator.***
Response: Please see Hampton comment number 43 above and comment 59 below. Any community participating in the NFIP must have an NFIP or floodplain administrator. Mr. Fred Whitley is the designated Floodplain Administrator or Floodplain Manager for the City of Hampton, according to the Virginia Dept. of Conservation and Recreation. We denoted "Floodplain Management", rather than NFIP Administrator, to address this comment.

58. ***Pg. 120, Cost Benefit: "resulting in approximately $219,000 (add "annual") savings"***
Response: Revised.

59. ***Pg. 121, Other Alternatives, Need to reword first sentence.***
Response: Revised.

60. ***Pg. 121, Responsible Office – Again, we do not have an NFIP administrator.***
Response: Please see comments 43 and 56 above. We denoted "Floodplain Management", rather than NFIP Administrator, to address this comment.

61. ***Pg. 122, Responsible Office includes Codes Compliance, Procurement, Public Works, Floodplain Management. Cost estimate is more around $40,000 - $60,000 per structure – remove total of $500,000. Cost benefit - …"when structures are elevated (replace "to or" with 1 foot) above Base Flood Elevation."***
    Response: Revised.

62. ***Pg. 123: Issue / Background – Outside 100-year floodplain. Responsible Office – Hampton City Schools, NFIP Administrator (?), Office of Emergency Management. Schedule – After first sentence, include "Grant denied. Future funding opportunities will determine schedule to complete this item."***
    Response: Revised.

63. ***Pg. 124, Action Item 5 – based on BRAC, may want to include Buckroe through Ft. Monroe. Responsible Office – NFIP administrator in brackets, not consistent with previous statements. Schedule – see previous comment on pg. 123. (Grant denied…)***
    Response: Revised.

64. ***Pg. 125 – Potential Funding – DHS grants. Schedule – Grant denied… (see pg. 123, 124)***
    Response: Revised.

65. ***Pg. 126 – Wiring existing shelters and critical facilities (this is fine). Approximately 20 facilities (add and 20 pump stations) will be prewired for generator power. Responsible Office – Include Hampton City Schools, remove American Red Cross. Cost Benefit – Should read "Providing ability to contract for and install back generator power to shelters… Potential Funding – include CIP, other grant opportunities… Schedule – Add "Grant denied… (see pages 123, 124, 125).***
    Response: Revised.

66. ***P.127 – cost estimate – add "there would be a cost to the builder to elevate an additional 2'."***
    Response: Revised.

67. ***Pg. 128 – Issue/Background – The answer to your question depends on the scenario. Certainly volunteers could conduct windshield assessments, but also report post-event conditions to the EOC, serve as a means of communications throughout the neighborhoods, traffic control, etc. This is where CERT / Citizen Corps come in.***
    Response: Revised.

68. ***Pg. 129, Action Item #10, Issue/Background: First sentence – instead of citing specific areas in the City, just say there is a city-wide history of flooding. Other Alternatives Considered: Should read "No action to preserve or create open space in the floodplain may result in residential…" Cost Estimate: Not high enough. Potential Funding – define HMGP, PDM, FMA, CDBG.***
    Response: Revised as requested, except all acronyms will be fully described in an appendix to this document. Included an additional $1,000,000 in Cost Estimate.

Reviewer: Wilton Bobo
Agency: James City County

69. ***Pg. 105, Number of Floodprone Buildings is 200.***
    Response: Revised.

70. ***Pg. 107. 2003 Comprehensive Plan, last paragraph. Add Powhatan District after Berkeley in first sentence.***
    Response: Revised.

71. ***Pg. 108. Public Education, last paragraph. Change Environmental Division to Development Management.***
    Response: Revised.

Reviewer: Emily Flannigan
Agency: Newport News

72. **Pg. 68 and 69. Remove question marks from Capability Matrix.**
Response: Revised.

73. **Pg. 71, Emergency Preparedness, Storm Ready. Revise 1st sentence to read, "Newport News was one of the first 5 communities in Virginia to be Storm Ready. Storm Ready is a nationwide . . . ."**
Response: Revised.

74. **Pg 72. Last paragraph. Remove the phrase, "outside of the floodplain."**
Response: Revised.

75. **Pg. 131. Action Item #3, Action Description. Add phrase, "which are certified by the American Red Cross" to clarify.**
Response: Revised.

76. **Pg. 131. Issue/Background. Add the following sentence at the end, "During Hurricane Isabel, the shelters were left without power."**
Response: Revised.

77. **Pg. 132. Issue /Background. Add the following sentence at the end, "Future plans for acquired areas include park uses in allowed floodway."**
Response: Revised; modified wording slightly to read "regulatory floodway."

78. **Pg. 132. Schedule. Add the following sentence at the end, "To date, about thirty homes have been acquired through the FAP."**
Response: Revised.

79. **Pg. 135. Responsible Office, include Planning. Cost Estimate, denote "Staff Time."**
Response: Revised.

80. **Pg. 136. Responsible Office, include Emergency Management. Cost Estimate, denote "$25,000."**
Response: Revised.

81. **Pg. 138. Action Item #10, include introductory phrase, "Upgrade drainage system maintenance and increase maintenance frequency . . . ."**
Response: Revised.

82. **Pg. 138. Issue Background, include final phrase, "system, which has resulted in flooding problems in low-lying areas such as City Line Apartments. Presently, City crews visit hot spots during intense rain storms resulting in extra man power and additional hours."**
Response: Revised.

83. **Pg. 138. Include Action Items 11 (Flood Hazard Awareness Program) and 12 (Community Rating System participation).**
Response: Revised.

Reviewer: Judi Riutort
Agency: York County
Note: Ms. Riutort provided comments via an edited document. Her version was wholly included in the main document, and the most important comments are summarized below.

84. **Pg. 147. Responsible Office, use "Dept of Environmental and Developmental Services, Building Regulations". Schedule should indicate, "Implementation contingent on funding and staffing availability."**
Response: Revised.

85. **Actions Items 2 and 3. Reorder items so that 2 and 3 become 4 and 5, and vice versa.**
Response: Revised.

86. **Pg. 148. Reword first action item as indicated in revised document provided to AMEC. Reword Issue/Background and include Office of Emergency Management, and Department of Fire & Life Safety under Responsible Office. Cost estimate should be increased to $120,000. Revise Schedule to read, "Implementation contingent upon . . . ."**
Response: Revised.

87. **Pg. 148. Reword 2nd action item, Issue/Background, and Other Alternatives Considered. Responsible office should be County administration, Planning Division and the York Co Board of Supervisors.**
Response: Revised.

88. **Pg. 149. Reword Responsible Office for first action item on page. Change Priority to "High". Change Schedule to "Ongoing."**
Response: Revised.

89. **Pg. 149. Reword Issue/Background for the 2nd action item on page. Take out sentence referring to VDOT maintenance. Change Priority to "High. Increase Cost Estimate to $5,000,000, reword Cost Benefit, and include VDOT Revenue Sharing Program funds as a Potential funding source.**
Response: Revised.

90. **Pg. 149. York County included 8 additional action items in their comments which were included in the revised draft of the hazard mitigation plan.**
Response: Revised.

Reviewer: Bill Sammler
Agency: NWS Wakefield Office

91. **Hurricane Map – Hurricane track arrows are 180 degrees opposite what they should be. Also, there is considerable difference between the track data and the impact data in the body of the text, most likely due to the fact that most tropical systems which affect the Peninsula do NOT pass directly over the Peninsula.**
Response: Revised using NOAA CSC mapping tool.

92. **Earthquakes (pp. 17) – data should also be derived from the USGS Virginia page, which has more current information.**
Response: Revised using data from USGS Virginia page and the Virginia Tech Seismological Observatory data. Table revised by striking non-Virginia quakes and adding recent data collected from various sources.

93. **Thunderstorms (pp.21-22) – VA averages 40-50 thunderstorm days per year (vs. 35-45). A better lightning strike density map should be available from the Internet. The use of a 1 year sample as a climatology (Figure 4.1.3a) is simply not valid. In addition, the last paragraph on page 21, and the table on page 22 do not depict lightning strikes, but depict incidents of lightning strike damage and/or deaths since about 1990. This is likely only a fraction of the actual damage, and deaths/injuries during that time. In addition, there is no data on hail/high wind damage/deaths as a result of severe thunderstorms. This data can be obtained by using the SVRPLOT2 software available from the Storm Prediction Center in Norman OK.**
Response: Revised text as indicated. Another lightning strike density map could not be located; however, discussion was added and the figure title revised to indicate that this is a 1-year climatology only. SVRPLOT was used to create maps in Appendix C showing hail, high winds, and tornadoes as suggested.

94. **Extreme Heat (pp22-23) – Table 4.1.4a is a Heat Index table, not a table of temperature vs. RH. Suggested to AMEC that a 30% RH column be added. This is NOT a valid suggestion, as the NWS Heat Index table ends at 40%.**

Response: Revised table title and added column descriptors.

95. **Flooding (pp 23-24) – 3rd full paragraph on page 23, suggest starting with "There have been numerous urban and flash floods…", as not all the flooding has been flash flooding. In fact, Isabel was not a flash flood due to rainfall, but Floyd had flash flooding, urban flooding, and longer term river flooding associated with it.**
Response: Paragraph was substantially revised.

96. **Drought (pp. 24-26) – Need to discuss the 2000-2002 drought, which was the most significant since 1931 for most of VA. Attached are a couple of graphics from that time period. Eliminate graphic at top of page 26. It's not representative of drought.**
Response: Drought section was substantially revised to include data on 2000-2002 drought, and use U.S. Drought Monitor rather than Palmer Drought Severity Index.

97. **Hurricanes (pp. 26-28) – Lots of re-wording needed in the descriptive section (pages 26-27). 1933 Hurricane and Hurricane Hazel were missed completely, probably due to the lack of data in Storm Data, which really isn't a good source for pre-1980 hurricane impact information. Newspaper clipping/archives, etc. are much better, even though more work is required to obtain this info. I have attached a document we prepared locally that might help. Also suggest using a larger radius around the Peninsula (say 150 miles from the center of the Peninsula) to map hurricanes. This will be more representative of the storms that have impacted the region. NOAA's Coastal Services Center (CSC) has a hurricane track web site that should prove useful for this.**
Response: Hurricane section substantially revised. Mapping was not extended to 150 miles due to the community's desire to focus more closely on the Peninsula. NOAA CSC mapping site used to provide new mapping.

98. **Also Table 4.1.8b, Donna (1960) is missing. Ginger (1971) is included twice, Floyd was a TS, Dennis (1999) is misspelled, Isabel was an H1.**
Response: This table was deleted. Tables in Appendix C were edited to remove duplications.

99. **Nor'easters (pp. 29-30) – Not sure where the Dolan-Davis rating scale came from, and whether it's used operationally. We do not routinely use it.**
Response: This section was revised. Dolan-Davis scale remains in the plan, but a note was included that NWS and other media do not routinely use it. The table remains an insightful tool for describing varying degrees of damage.

100. **Tornadoes (pp30-32) – Need to use SVRPLOT to map occurrences, rather than using Barbara Watson's 1950-2000 map. Fujita scale is truncated at F4, should go through F5. In hurricane spawned tornadoes (table 4.1.10c), 5 tornadoes occurred on the peninsula with Gaston, not 1. There is also a discrepancy between the data showing hurricane occurrences and the data for hurricane spawned tornadoes.**
Response: This section was substantially revised. Table 4.1.10c was removed, and the information on associated hurricanes was added to the previous table to integrate the two databases and make the information more pertinent to the Peninsula. SVRPLOT maps for tornados, damaging wind, and hail were added to the Appendices.

101. **Wildfires (pp. 33) – Do not understand the meaning for the paragraph above Table 4.1.11a.**
Response: The paragraph in question was removed. Table of fire risk was revised to add land area w/in each community.

102. **Winter Storms (pp 34-36) – Why aren't most of the storms listed in Table 4.1.12a also in the Nor'easter table (4.1.9b)? Most of the winter storms listed in 4.1.12a are also nor'easters.**
Response: The nor'easter table was revised to include those winter storms *known* by editors to also be nor'easters.

103. **Sections 4.1.16/4.1.17 (pp. 38-39) – Section 4.1.16 needs to be re-worded, as the message is unclear. Table 4.1.17a is confusing to me, and I need to understand the logic behind the Hazard Level designations.**

Response: Text from 4.1.16 was moved forward in the document to ensure that this discussion is seen prior to the multi-hazard identifications, and readers understand that hazards can be interrelated. The hazard level designations in Table 4.1.17a were reviewed by the editors; however, ultimately, the team members themselves came up with the rankings and hazard levels, and the editors do not feel justified in changing them w/out community input.

104. **Jurisdictional Comments – Similar data issues appear to exist in the individual jurisdiction data. There appears to have been multiple data sources used, but little cross-checking between sources to ensure the data is complete, reasonable and accurate.**
Response: The individual sections were reviewed and revised as appropriate.

Comments and Responses to the Draft Natural Hazard Mitigation Plan, dated Sept 30, 2005
Draft #4

Reviewer: Jim Redick
Agency: City of Hampton

1. **Pg. K-2. Mr. Redick's name was misspelled in this appendix.**
   Response: Revised.

2. **Pg. 9, Section 2.1. Reword second sentence of first paragraph to read, "The area now occupied by Hampton was first noted by English colonists. . . when they visited an Indian village called Kecoughtan."**
   Response: Revised.

3. **Pg. 148, Recommended Action #8. Reword action to include EM on site plan review, review of all development documents, processing Elevation Certificates and developing new forms for (eg) substantial damage.**
   Response: Revised.

4. **Mitigation recommendation #1 – elevate flood-prone homes. Generalize, don't specify 21 homes. This will be an ongoing strategy.**
   Response: Revised recommended action #3, and the Schedule notation, as well.

5. **Hurricane Dennis is mentioned under Tornados in Hampton, but not hurricanes. As Dennis stayed off the shore, it produced a good deal of rain and saturated the ground – allowing Floyd to cause more havoc.**
   Response: Revised. Also located and included local rainfall totals for Dennis and Floyd.

Hampton Map Comments

6. Please add a label at FR12 that indicates "City Hall".
   Response: Revised.
7. With regard to street names, add as many as possible to still make it legible.
   Response: Revised to the extent possible. Major roads where already included, however added a few more less primary roads. If more are added, clutter issues will develop.
8. Please add a label at FR12 that indicates "City Hall".
   Response: Revised.
9. Please add Hampton Roads Convention Center and Hampton Coliseum.
   Response: This comment was overlooked and will be addressed in the next revision.

Reviewer: Randy Hildbrandt et al (city officials meeting 10/12/05)
Agency: City of Newport News

10. **Newport News Mitigation Action Item #5. Remove this item as it is an ongoing program with sufficient funding. Waterworks does not plan to devote additional funding.**
    Response: Revised

11. **Mitigation recommendation #10. City Line flooding is not a result of inadequate drainage maintenance. Revise wording.**
    Response: Revised

Reviewer: Mostafa Sabbah
Agency: City of Newport News

12. **Pg. 151, Action Item #2. The City does not collect completed Elevation Certificates but collects data from the ECs. Engineering should be added to the responsible parties.**

<u>Response:</u> Revised.

13. **Pg. 152, Action Item #3. Engineering should be added to the responsible parties. This is currently the subject of a major study being managed by Engineering. Costs seem VERY low. Potential grant funding is helpful.**
    Response: Revised. Increased costs substantially.

14. **Pg. 152. Action Item #4. The $200K cost estimate represents only the annual City contribution and does not include FEMA funding obtained annually.**
    Response: Revised to read "$200,000 annual City funding, plus any grant funding that may become available. Program can be expanded based on available funds."

15. **Pg. 155, Action Item #7. Engineering and City Attorney should be added to the responsible parties.**
    Response: Revised.

16. **Pg. 157, Action Item #10. The background misrepresents maintenance deficiency as the cause of City Line flooding, which is actually more a function of tidal influence. It is unclear whether recent significant staff and equipment upgrades were considered in this recommendation.**
    Response: Revised. Removed reference to $1.30 per month and left it up to future stakeholders to set fee increase.

17. **Pg. 157, Action Item #11. Engineering is in discussion with Codes about integrating the building permit process with the City GIS, which would allow for direct linkages with mapping including the FIRM mapping. By including more detailed data, such as a full EC, in the application and approval process, we expect to increase the level of awareness significantly.**
    Response: Revised to include discussion of the plans referenced above.

Reviewer: Stormwater Division, Stephen Land and Emergency Management, Emily Flannigan
Agency: City of Newport News

18. **New Action Item #13. Mr. Land and Ms. Flannigan provided a new Action Item regarding floodproofing of 4 pump stations in the 100-year floodplain.**
    Response: Revised to incorporate new Action Item.

Reviewer: Fran DeMarco
Agency: Homeowner, City of Newport News (at Public Meeting #8, 11/2/05)

19. **Table 5.2.2. During Hurricane Floyd there was significant flooding in the northern part of Newport News, near Newport News Park. There was a townhome community where many families were affected by flooding up to the 2nd floor of their homes. I understood it was a drainage problem. The Hampton Roads Chapter of the ARC might be able to provide more details.**
    Response: Revised to include discussion of the townhomes, and to include newly discovered data on rainfall amounts in Newport News.

<u>Newport News Map Comments</u>

20. Check once more for symbols and labels overlapping.
    Response: Overlapping symbols were not moved due to the spatial inaccuracies that would be created. Review of overlapping labels has been performed and several overlapping labels were repositioned.
21. Remove trailer parks.
    Response: Revised.
22. Nursing home symbol on legend isn't quite the same as the symbol
    Response: Revised. Same symbol is represented in legend and map; however, tried to enlarge symbol in legend to make more visible.
23. Symbols layers need to be on top of water layer. East end and Mercury Blvd, there are some symbols obscured by water
    Response: Revised.

24. Label creek names, from left to right:
  a. Along James City Co border, it's Skiffe's Creek
  b. Upper left near FR5, its Lee Hall Reservoir
  c. Next creek emptying into Warwick River near PS54, is Toney Run
  d. Next creek near PS 108 is Lucas Creek
  e. Deep Creek is labeled
  f. Next creek is Fisher's Creek (near PS 92)
  g. Next waterbody is Lake Maury (near PS 22)
  h. Along the northeastern border w/York County is the Big Bethel Reservoir
  i. Along the boundary with City of Hampton, near the 90 degree angle and PS 96 is Newmarket Creek
  j Waterbody near PS 125 is Salter's Creek

Response: Revised.

Reviewer: Bert Geddy
Agency: City of Williamsburg

25. Revise Section 5.3.1 to include data on June 63 dam break, and Aug 89 rain event.

Response: Revised. Requested more info from B. Sammler, NWS, and will add what becomes available in time.

26. Pg. 91. Listing of "designated growth/redevelopment areas" should not include College Woods.

Response: Revised.

27. Pg. 84, Section 5.3.2. Second paragraph should be revised in accordance with the recommendations above for Section 5.3.1.

Response: Revised.

28. At PHMPC meeting, Mr. Geddy and Ms. Morgan discussed adding an action item for requesting a review of the floodplain management ordinance by VaDCR.

Response: Revised.

<u>**Williamsburg Map Comments**</u>

29. Add Lake Matoaka

Response: Revised.

30. Delete Water Tower 521, as it is the same as WT 548 3. PS 528 and an unlabeled pump station on the far east side. The symbols got cut off. Is there a way to put these on top of the county layer? Add label for the unlabeled PS.

Response: Revised.

Reviewer: Richard Luzinski
Agency: Homeowner, York County (at Public Meeting #8, 11/2/05)

31. James City County portions of the plan. The plan seemed thorough for "natural" events. But because of our location, planning for an event in Surry [Nuclear Power Plant] or the Naval Weapons Storage Depot in York [County], I feel, should have been taken into consideration.

Response: Mr. Luzinski's comment was discussed with local planners at the meeting. The focus of this plan is natural hazards. Local communities anticipate that the five-year update of this initial planning effort will provide opportunities to more fully integrate the multiple operations plans for individual events with natural hazard mitigation planning.

Reviewer: Wilton Bobo
Agency: James City County

32. Pg. 95, Section 5.4.1. Refine discussion of flooding to show that JCC is susceptible to tidal and non-tidal flooding, not just storm surge.

Response: Revised

33. **Pg. 107, Other Mitigation Activities. Third paragraph should be revised to indicate that Jamestown *Elementary* School and Stonehouse Elementary Schools are also prepared for an emergency generator.**
    Response: Revised

34. **Pg. 167, Action #1. Comments from AMEC and Mr. Bobo reflect a need to clarify that the Chickahominy Haven project is coincident with addressing repetitive losses.**
    Response: Revised

35. **Pg. 170, Action Item #6. Include discussion that the county has begun working with nursing homes, assisted living facilities, private schools and daycare centers on mitigation and disaster recovery.**
    Response: Revised

James City County Map Comments

36. Show the railroad continuing through W'burg and York Co as you did with the main interstate.
    Response: Revised.

Reviewer: Lou Lafrenayz,
Agency: Homeowner, York County (at Public Meeting #8, 11/2/05)

37. **Section 5.5.1. Mr. Lafrenayz provided general background on additional flood events and some urban flooding/drainage issues in York County and along the Newport News boundary at Little Brick Kiln Creek.**
    Response: Revised report to include discussion of the flood events with data provided, and discussion of water level management practices at Bethel Reservoir and Newport News Reservoir.

Reviewer: PHMPC Team Member
Agency: York County

38. **Pg. 176, Action Item #4. Revise action description, issue/background and cost estimate in accordance with revised text provided.**
    Response: Revised with minor editing.

Reviewer: Judi Riutort
Agency: York County

39. **Pg. 112, beginning of last paragraph. The parcel layer is now up to 25,100. If a specific number is included, then we should state a date or fixed point in time.**
    Response: Revised to reference data from Spring 2005.

40. **Pg. 121, Guiding Community Documents, 1st paragraph. Change "its'" to "its".**
    Response: Revised.

41. **Pg. 122, Zoning and Development Standards, 3rd line of 1st main paragraph. Delete "a".**
    Response: Revised.

42. **Pg. 116, Critical Facilities. Correct subject verb agreement in 1st sentence of 2nd paragraph.**
    Response: Revised for each community discussion of critical facilities.

43. **Pg. 116, Table 5.5.5d. The last entry is coded as "RE", and there is no RE in Appendix E, list of codes.**
    Response: Revised by deleting Yorktown Waterfront from Critical Facilities. Recreation facilities should not be listed as critical facilities.

44. **Pgs 117-120. Delete facilities as indicated on marked up sheets.**

Response: Revised.

45. **Pg. 120, Table 5.5.6. The Land Use Plan is part of the Comprehensive Plan, and the Class 9 CRS rating is now certified.**
    Response: Revised.

46. **Pg. 122, bulleted areas of growth and development. Delete "growth/redevelopment" and add "but not limited to". Reword 3rd bullet as indicated on markup.**
    Response: Revised.

47. **Pg. 124. The font of subtitle "Emergency Preparedness" is incorrect.**
    Response: Revised.

48. **Pg. 125. Add another subheading "Warning" after "the County's Department of Fire and Life Safety:"**
    Response: Revised.

49. **Provide a summary of AMEC's role in the planning process. Recommend inside front cover.**
    Response: Provided summary of AMEC's role in the Executive Summary.

50. **Ms. Riutort commented on critical facilities tables with instructions to remove some facilities that do not meet the definition of "critical".**
    Response: Revised. However, in Appendix E, first table, "DC" and "CL" cannot be removed because Newport News chose to keep these facilities on their maps.

<u>**York County Map Comments**</u>

51. Top center, label should read "Gloucester County", not "Cloucester"
    Response: Revised.

52. Put the water label on top of the floodplain layer so that we get some semblance of a shoreline. This should be applied to all communities.
    Response: Revised; but water layer is probably not what communities thought it would be.

53. Remove all hazardous materials from map and legend (and report.)
    Response: Revised.

54. "Poqueson River" must be spelled "Poquoson River" and put on the water, not on land (or add an arrow)
    Response: Revised.

55. Since orientation is not north-up, the symbols are all cock-eyed. Please rotate symbols.
    Response: Symbol orientation was created with initial set-up of map. Currently we do not have a quick fix to this issue as additional research will be needed for a resolution. This issue has not been addressed due to time constraints.

Reviewer: Kris Keyes
Agency: Newport News Waterworks

56. **Dams and water towers in JCC and Williamsburg must be removed.**
    Response: These facilities have been removed from the plan and tables, and will be removed from the maps when the final maps are produced.

57. **Page 153**, **Rec Action Item #5, Issue/Background**: The first two lines should be changed to read as follows. The other lines in the paragraph should remain the same. "Department of Public Utilities (Newport News Waterworks) developed a water conservation program approximately 15 years ago and was modified in 2005 (effective January, 2007). The pan is based on encouraging water conservation through surcharges and penalties for excess use, and restrictions during drought conditions. This plan...."
    Other Alternatives Considered: Delete the sentence "The plan is under revision, to be effective FY2006."
    Page 179, Rec Action Item #9: Should be the exact same changes as above for page 153.
    Response: Revised.

Comments and Responses to the Draft Natural Hazard Mitigation Plan, dated November 18, 2005
Draft #5

Reviewer: Hibak Hersi
Agency: Virginia Department of Emergency Management

1. **Planning Process Element D (Crosswalk p.5) –** We included several sentences in Section 3 (Steps 1 and 3) to indicate that project managers invited Hampton University, Thomas Nelson Community College, the College of William & Mary, the SE Community Redevelopment Office, and school systems. Businesses were invited to participate in the team planning process through an invite extended to the Peninsula Chamber of Commerce. Non-profits were addressed through the public comment periods and notifications in local newspapers. We indicated that the letters and emails of invitation to these groups are not included in the plan, but maintained by Newport News Emergency Management.
2. **Profiling Hazards, Element B (Crosswalk p. 6) –** As you and I discussed, the surge maps are intended to be a part of the plan and we will be sure to include all community surge maps in the new submittal. We have included a complete subsection regarding storm surge and storm surge mapping in Section 4.1.3. We kept the surge discussion as a subsection of Hurricanes and Tropical Storms because the surge is a secondary hazard caused by the tropical systems; it can't occur on its own. We feel that the local erosion hazard is, likewise, a secondary hazard related to storms and sea level rise, so we added language to this effect in Section 4.1.1, Multi-Hazard Correlation. We provided a further description of erosion under nor'easters, and then include community-specific references for York Co b/c erosion is addressed in their Comprehensive Plan (see Section 5.5.4). The communities were asked to provide whatever additional info they could on winter storms and nor'easters on several occasions. They do not maintain collected records and have next to no data on damages or costs. Upon further inquiry, AMEC received some limited information from York County. They provided some general cost estimates on recent storms which were included in the text, however, the few sentences on separate hazards did not justify entire community sections devoted to these hazards so the data was included in the historical descriptions of events for the entire planning region in Table 5.5.1b.
3. **Assessing Vulnerability: Identifying Structures (Crosswalk p. 7) –** No change to the plan. We will recommend that the communities consider including future development plans in the plan when they do a 5-year update.
4. **Multi-Jurisdictional Risk Assessment (Crosswalk p.9) –** We understand the inclusion of "Thunderstorms" was a mistake, and that "Nor'easters" was intended. Under Risk Assessment, VDEM has asked that we address Nor'easters, winter storms, storm surge, and erosion more thoroughly for each jurisdiction. Again, erosion and storm surge are secondary hazards as they are a result of storms and/or sea level rise. The discussion of erosion and storm surge is addressed for each *storm* through the Hurricane discussions and the very detailed descriptions of individual historical hurricanes and their effects on regional jurisdictions. Please note that Appendix C, Catalog of Virginia's Historical Hurricanes, provides detailed accounts of the effects of storm surge and erosion resulting from hurricanes since the mid-1500s. As FEMA requires that the risk assessment assess each jurisdiction's risk "*where they vary from the risks facing the entire planning area*", we are puzzled at how to differentiate between the jurisdictions with regard to winter storms and Nor'easters. All of the Peninsula is subject to these storms, and all jurisdictions have suffered their effects on many occasions over their history. The effects are often hard to quantify as they are primarily incurred by individual homeowners as a result of power outages, and by local governments from clearing/prepping roads. We attempted to contact Virginia Dominion Power and the Media Relations department thereof to determine the extent, duration, and costs of power outages as a result, and we again asked the communities to provide any data of costs from these storms. We did not receive any response from any of them. Additional data added to 4.1.16 on tsunamis, as available.
5. **Implementation of Mitigation Actions (Crosswalk p.11) –** We will modify wording of several Recommended Actions to include "continued compliance with the NFIP", as this is the overall intent of the recommended actions. We will also provide a sentence that all communities are planning to have continued compliance with the NFIP.

References

Boesch, Donald and Jack Greer, et al. *Chesapeake Futures; Choices for the 21st Century Chesapeake Bay Program*, undated, available for viewing at http://www.chesapeake.org/stac/futreport.html

Boston Globe, 2004, N.E. is not immune, scientists warn. December 28, 2004.

Conrad, D., McNitt, B., and Stout, M., 1998. *Higher Ground: A Report on Voluntary Property Buyouts in the Nation's Floodplains, A Common Ground Solution Serving People at Risk, Taxpayers and the Environment*. National Wildlife Federation, Washington, D.C., July 1998.

Driscoll, N.W., Weissel, J.K., and Goff, J.A., 2000, *Potential for large-scale submarine slope failure and tsunami generation along the US mid-Atlantic Coast (pdf). Geology:* May 2000, v. 28, no. 5, p. 407-410.

Fujita 1971. Fujita Damage Scale. (Online). Available at http://www.ncdc.noaa.gov/oa/satellite/satelliteseye/educational/fujita.html

Maine Geological Survey (Online), *Tsunamis in the Atlantic Ocean*, at http://www.maine.gov/doc/nrimc/mgs/explore/hazards/tsunami/jan05.htm. October 2005.

NOAA 1999. National Oceanic and Atmospheric Administration, National Weather Service. Climate of 1999 – June – August; Drought in the U.S., 15 September 1999. (Online). Available at http://www.ncdc.noaa.gov/oa/climate/research/1999/sum/us_drought.html#heat. 8 December 2004

NOAA Technical Report NOS CO-OPS 36, *Sea Level Variations of the United States 1854-1999*, July 2001.

NOAA 2004. National Oceanic and Atmospheric Administration, National Weather Service. (Online). Available at http://www.crh.noaa.gov/pub/heat.htm. 8 December 2004.

NWUIFPP undated. Wildland/Urban Interface Fire Hazard Methodology. National Wildland Urban Interface Fire Protection Program, undated. (Online) Available at http://www.fema.gov/pdf/reg-viii/wham.pdf

Office of Technology Assessment, United States Congress, *Preparing for an Uncertain Climate*, 1993.

Sammler, William. Personal interview, September 15, 2005. (National Weather Service, Warning Coordination Meteorologist, Wakefield, Virginia office.)

United States Geological Survey (Online) *Earthquake History of Virginia, a*vailable at http://neic.usgs.gov/neis/states/virginia/virginia_history.html, 2004.

Virginia Department of Emergency Management. (Online) *Virginia Winters; Snow, Wind, Ice, and Cold.* Available at: http://www.vdem.state.va.us/library/vawinter/va-win.htm 2004.

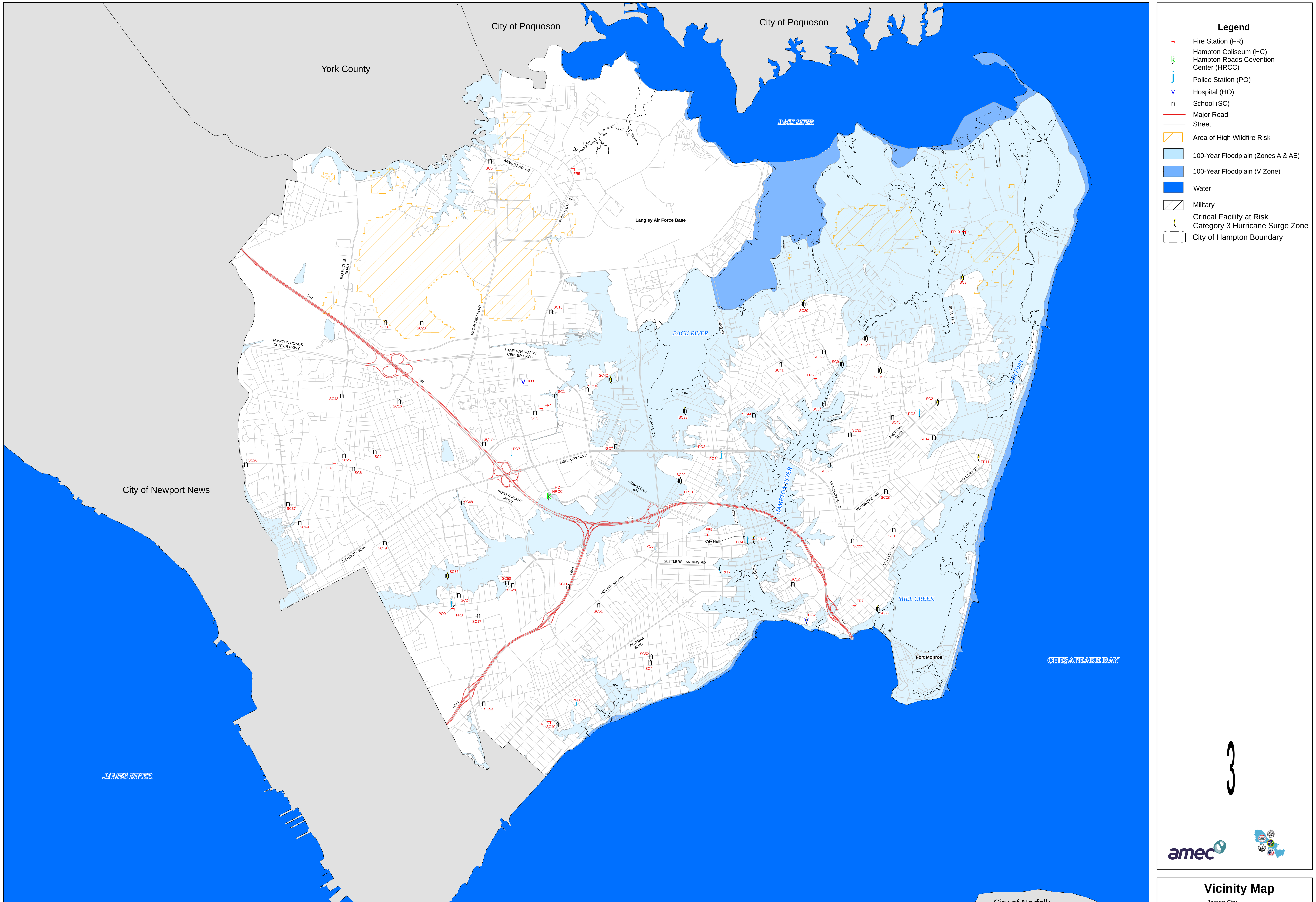
Virginia Drought Monitoring Task Force, *Drought Status Report*, August 19, 2002 and November 25, 2002.

Virginia Employment Commission, Electronic Labor Market Analysis. (Online). Available at: http://velma.virtuallmi.com/analyzer/startanalyzer.asp. 2005

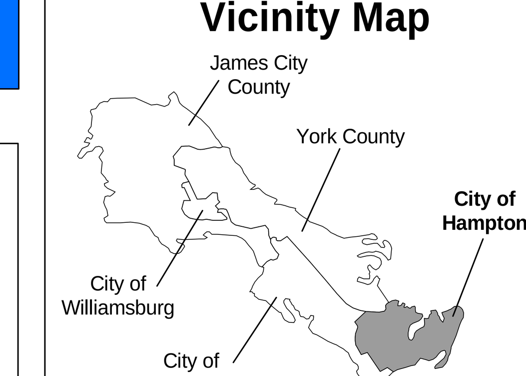
Virginia Soil and Water Conversation Board. (Online) Available at http://www.dcr.virginia.gov/sw/damsafty.htm

Virginia Tech Seismological Observatory. (Online) Available at http://www.geol.vt.edu/outreach/vtso/ and http://www.geol.vt.edu/outreach/vtso/Giles-Intensity.htm.

Weldon Cooper Center for Public Service, *Population Estimates for Virginia Cities & Counties, 2001-2004* (Online) Available at: www.coopercenter.org/demographics, January 2005.



Vicinity Map



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Data Sources:
The Virginia Department of Forestry provided the wildfire risk layer.
The City of Hampton GIS Department provided the following data layers:
Fire Departments
Hospitals
Police Stations
Schools
Storm Surge Zones
Flood Zones
Streets and Rail

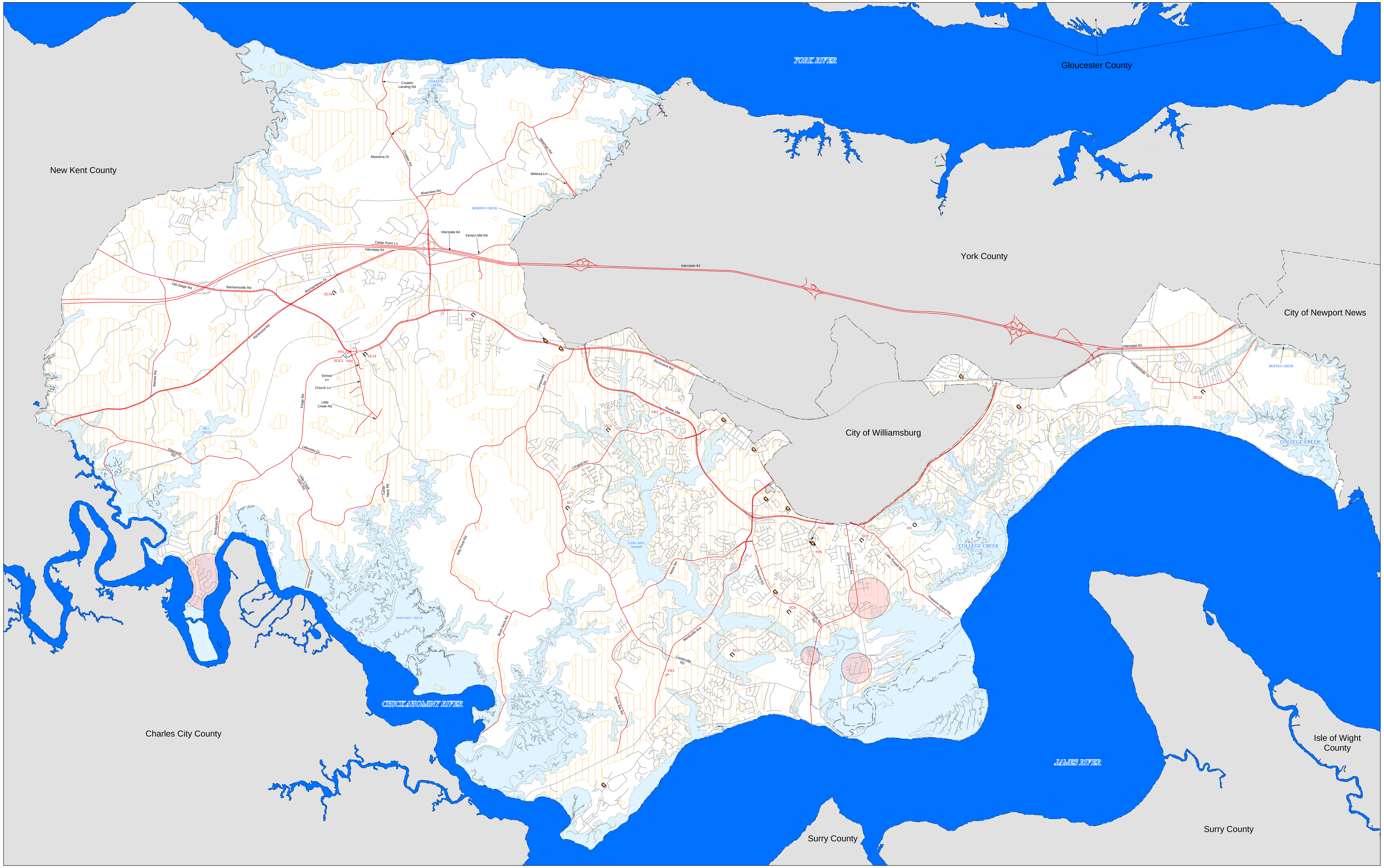
1:24,000

0 2,125 4,250 8,500 Feet

Peninsula Multi-Jurisdictional Natural Hazards Mitigation Plan

September 2005

City of Hampton, Virginia Multi-Hazards Map



Legend

- Emergency Operations Center (EC)
- Fire Station (FS)
- Police Station (PS)
- School (SC)
- Airport (AI)
- Major Roads
- Streets
- Rail
- County Boundary
- Area of High Wildfire Risk
- 100-Year Floodplain
- Problem Areas As Defined By County Officials
- Water

amec

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Critical facilities identified on this map are by GEOCODE. See Hazard Mitigation Plan for listing of all critical facilities.

Data Sources:

The Virginia Department of Forestry provided the wildfire risk layer.
HAZUS data from the Federal Emergency Management Agency were used for police station, fire station, hazardous materials, and health care locations.
The James City County GIS Department provided the following data layers:
Flood Zones
Roads
Rails
Schools

1:36,000

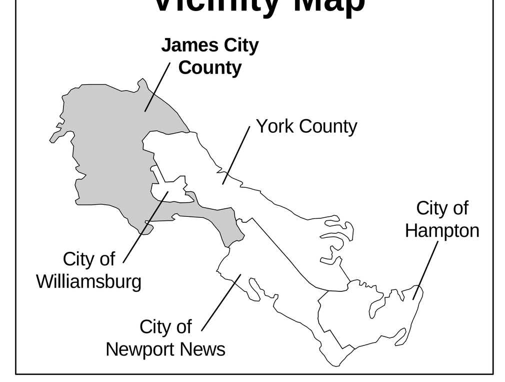
0 3,800 7,600 15,200 Feet

Peninsula Multi-Jurisdictional Natural Hazards Mitigation Plan

September 2005

James City County, Virginia Multi-Hazards Map

Vicinity Map



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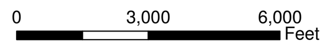
Data Sources:

The Virginia Department of Forestry provided the wildfire risk layer.
HAZUS data from the Federal Emergency Management Agency were used for police station, schools, and hazardous materials locations.
The City of Newport News GIS Department provided the following data layers:
Emergency Operations Centers
Fire Departments
Hospitals and Clinics
Day Care Centers
Nursing Homes
Trailer Parks
Pump Stations
Stormwater Pump Stations
Storm Surge Zones
Flood Zones
Streets and Railroads

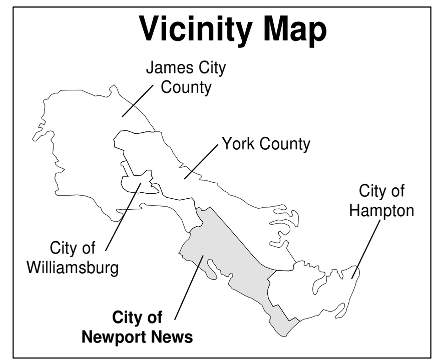
1:24,000



Peninsula Multi-Jurisdictional Natural Hazards Mitigation Plan

September 2005

City of Newport News, Virginia Multi-Hazards Map



PENINSULA MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN

DISASTER MITIGATION ACT OF 2000

January 2006

Executive Summary

The rich historical assets and vast natural resources of the Lower Virginia Peninsula have a long history of vulnerability to a multitude of natural hazards. From colonial-era hurricanes that moved immense quantities of sand to create the spits, points, and creeks of today, to recent tornados that displaced elderly inhabitants, the Peninsula's residents live with the history of past events and constantly strive to prevent damage from future events.

In order to reduce or eliminate the long-term risk to human life and property from natural hazards, the communities of the Lower Virginia Peninsula joined forces to prepare this Multi-Jurisdictional Natural Hazard Mitigation Plan. Comprised of local government representatives from Hampton, Newport News, Williamsburg, James City County and York County, the Peninsula Hazard Mitigation Planning Committee (PHMPC) met regularly over the course of 12 months during 2004 and 2005, to generate the elements of this plan. The elected boards of each jurisdiction reviewed and officially adopted the plan, making it a governing document for their community. AMEC Earth and Environmental was contracted to assist the committee throughout the planning process. AMEC's role included facilitating all meetings of the PHMPC, preparing presentations for all Public Meetings, and instructing committee members about the role of mitigation in hazard preparedness. AMEC coordinated the reviews and comments of committee members, other state agencies including VDEM, and FEMA.

This plan has been prepared in accordance with the requirements of the Disaster Mitigation Act of 2000. This legislation reinforced the importance of pre-disaster infrastructure mitigation planning to reduce disaster losses nationwide, and was aimed primarily at streamlining federal disaster relief and programs to promote mitigation activities. By adopting this plan, the communities of the Peninsula will be better prepared to integrate mitigation actions into other community programs by:

- building public support for mitigation activities,
- developing effective public education policies regarding mitigation, and
- obtaining disaster-related grants in the aftermath of a disaster.

The elements of this plan coincide with the primary planning tasks performed by the PHMPC. First, the committee conducted a risk assessment by analyzing and prioritizing the critical natural hazards that threaten the region: floods, hurricanes, nor'easters, winter storms, tornados, and wildfires. The vulnerability of each community to each critical hazard was examined in terms of assets at risk by dollar value, and critical facilities (police/fire stations, hospitals, schools, etc.) at risk. A capability assessment examined existing programs and mechanisms in place to mitigate the effects of natural hazards.

Armed with a detailed risk assessment, the PHMPC set regional mitigation goals to address areas where improved capabilities could reduce vulnerability. Goals, and objectives for achieving the goals, were further refined into mitigation alternatives, or "recommended action items". These detailed tasks for each community form the crux of the plan, and can be broken down into the following categories:

- prevention,
- property protection,
- structural projects,
- natural resource protection,
- emergency services, and
- public information.

With the adoption of this plan, each community's sub-committee is converted to a permanent advisory body referred to as the Mitigation Coordinating Committee (MCC) whose primary duty is to see the plan successfully carried out. Plan maintenance must be an ongoing effort to monitor and evaluate the implementation of the plan, and to update the plan as progress, roadblocks, or changing circumstances are recognized. Monitoring and updating will take place through an annual review by the MCC and a five-year written update to be submitted to the Virginia Department of Emergency Management and FEMA Region III, unless disaster or other circumstances lead to a different timeframe.

TABLE OF CONTENTS

PAG E

1.0 Introduction 5
1.1 Scope 5
1.2 Plan Organization 6
2.0 Regional Profile 7
2.1 History of the Peninsula Region 9
3.0 Planning Process 13
4.0 Hazard Identification and Risk Assessment 19
4.1 Hazard Identification 19
4.1.1 Multi-Hazard Correlation 21
4.1.2 Flooding 22
4.1.3 Hurricanes and Tropical Storms 23
4.1.4 Tornados 27
4.1.5 Nor'easters 29
4.1.6 Thunderstorms 32
4.1.7 Winter Storms 34
4.1.8 Extreme Heat 36
4.1.9 Dam Failure 37
4.1.10 Wildfire 38
4.1.11 Drought 39
4.1.12 Earthquakes 41
4.1.13 Biological Hazards/Epidemics 49
4.1.14 Landslide 50
4.1.15 Expansive Soils 50
4.1.16 Tsunami 50
4.1.17 Sea Level Rise 51
4.1.18 Critical vs. Non-critical Hazards 52
5.0 Community Specific Profiles 55
5.1 City of Hampton Profile 58
5.1.1 Flooding – City of Hampton 58
5.1.2 Hurricanes – City of Hampton 59
5.1.3 Tornados – City of Hampton 60
5.1.4 Wildfire – City of Hampton 61
5.1.5 Vulnerability Assessment – City of Hampton 62
5.1.6 Capability Assessment – City of Hampton 67
5.2 City of Newport News Profile 73
5.2.1 Flooding – City of Newport News 73
5.2.2 Hurricanes – City of Newport News 74
5.2.3 Tornados – City of Newport News 75
5.2.4 Wildfire – City of Newport News 76
5.2.5 Vulnerability Assessment – City of Newport News 76
5.2.6 Capability Assessment – City of Newport News 83
5.3 City of Williamsburg Profile 90
5.3.1 Flooding – City of Williamsburg 90
5.3.2 Hurricanes – City of Williamsburg 91
5.3.3 Tornados – City of Williamsburg 92
5.3.4 Wildfire – City of Williamsburg 93
5.3.5 Vulnerability Assessment – City of Williamsburg 93
5.3.6 Capability Assessment – City of Williamsburg 96
5.4 James City County Profile 101

5.4.1 Flooding – James City County 101
5.4.2 Hurricanes – James City County 102
5.4.3 Tornados – James City County 103
5.4.4 Wildfire – James City County 104
5.4.5 Vulnerability Assessment – James City County 104
5.4.6 Capability Assessment – James City County....107
5.5 York County Profile 114
5.5.1 Flooding – York County....114
5.5.2 Hurricanes – York County....116
5.5.3 Tornados – York County 118
5.5.4 Erosion – York County....118
5.5.5 Wildfire - York County 119
5.5.6 Vulnerability Assessment – York County 120
5.5.7 Capability Assessment – York County....127
5.6 State, Regional, and Federal Capabilities 136
6.0 Mitigation Goals and Objectives 143
6.1 Review of Mitigation Alternatives....145
6.1.1 Using Criteria to Analyze and Select Mitigation Measures....146
6.1.2 Reaching Consensus by Prioritizing Mitigation Measures....147
6.1.3 Action Plan 149
6.2 The Mitigation Strategy....150
6.3 Peninsula Mitigation Recommendations 151
6.3.1 Hampton Mitigation Recommendations....151
6.3.2 Newport News Mitigation Recommendations....160
6.3.3 Williamsburg Mitigation Recommendations....169
6.3.4 James City County Mitigation Recommendations 176
6.3.5 York County Mitigation Recommendations....183
7.0 Plan Implementation and Maintenance....194
7.1 Maintenance....195

LIST OF TABLES

PAGE

Table 1.2 Plan Organization 6
Table 2a Regional Population Statistics 8
Table 2b 2004 Annual Building Permit Data 8
Table 3a DMA 2000/CRS Planning Requirements....13
Table 3b PHMPC Meeting Focus....15
Table 3c Public Input Meeting Dates 16
Table 4.1 Presidential Disaster Declarations in Virginia, 1953 –2005....20
Table 4.1.3 Saffir-Sampson Scale 25
Table 4.1.4a Fujita Damage scale....28
Table 4.1.4b Significant Historical Tornados Impacting the Peninsula....29
Table 4.1.5a Dolan-Davis Nor'easter Intensity Scale 30
Table 4.1.5b Historic Virginia Nor’easters....31
Table 4.1.6 Recent Lightning Damage for Peninsula Communities*....33
Table 4.1.7 Significant Winter Storm Events....35
Table 4.1.8 Heat Index 36
Table 4.1.9 Number of Dams by Community and Hazard Classification 38
Table 4.1.10 Wildfire Hazard for Peninsula Communities....39
Table 4.1.11 U.S. Drought Monitor, Drought Severity Classification 40
Table 4.1.12a Modified Mercalli Intensity Scale 44
Table 4.1.12b Summary of Virginia Earthquake Data 48

Table 4.1.17	Hazard Identification Results	53
Table 5-	Capability Matrix (Example)	56
Table 5.1.1a	Significant Flood Events	58
Table 5.1.1b	NCDC Significant Flood Events –City of Hampton	59
Table 5.1.3	Historic Tornados – City of Hampton	61
Table 5.1.5a	Summary of Flood Analysis – City of Hampton	62
Table 5.1.5b	Value of Structures Exposed to High Wind – City of Hampton	64
Table 5.1.5c	Summary of Probabilistic Analysis – Residential Structures – City of Hampton	64
Table 5.1.5d	Critical Facilities at Risk – 100-Year Floodplain	66
Table 5.1.5e	Critical Facilities at Risk –Surge Zone Hurricane Category 4	66
Table 5.1.5f	Critical Facilities at Risk - High Wildfire Hazard Zone	66
Table 5.1.6	Capability Matrix – City of Hampton	67
Table 5.2.1a	Significant Flood Events	73
Table 5.2.1b	NCDC Listed Significant Flood Events –City of Newport News	74
Table 5.2.2	Historic Hurricanes – City of Newport News	74
Table 5.2.3	Historic Tornados – City of Newport News	76
Table 5.2.5a	Value of Exposed Structures from HAZUS®MH – City of Newport News	78
Table 5.2.5b	Summary of Probabilistic Analysis – Residential Structures – City of Newport News	78
Table 5.2.5c	Critical Facilities in 100-Year Floodplain	80
Table 5.2.5d	Critical Facilities at Risk - Surge Zone Hurricane Category 4	80
Table 5.2.5e	Critical Facilities at Risk - High Wildfire Hazard Zone	83
Table 5.2.6	Capability Matrix – City of Newport News	83
Table 5.3.1a	Significant Flood Events – City of Williamsburg	90
Table 5.3.1b	NCDC Listed Significant Flood Events –City of Williamsburg	90
Table 5.3.2	Historic Hurricanes – City of Williamsburg	92
Table 5.3.3	Historic Tornados – City of Williamsburg	92
Table 5.3.5a	Value of Exposed Structures from HAZUS®MH – City of Williamsburg	94
Table 5.3.5b	Summary of Hurricane Probabilistic Analysis on Residential Structures – Williamsburg	95
Table 5.3.5c	Critical Facilities at Risk – High Wildfire Hazard Zone	96
Table 5.3.6	Capability Matrix – City of Williamsburg	96
Table 5.4.1a	Significant Flood Events – James City County	101
Table 5.4.1b	NCDC Listed Significant Flood Events –James City County	102
Table 5.4.2	Historic Hurricanes – James City County	103
Table 5.4.3	Historic Tornados – James City County	104
Table 5.4.5a	Total dollar value of Exposed Structures from HAZUS®MH – James City County	106
Table 5.4.5b	Summary of Probabilistic Analysis – Residential Structures – James City County	106
Table 5.4.5c	Critical Facilities at Risk - High Wildfire Hazard Zone	107
Table 5.4.6	Capability Matrix – James City County	107
Table 5.5.1a	Significant Flood Events – York County	114
Table 5.5.1b	NCDC Listed Significant Flood Events –York County	115
Table 5.5.2	Historic Hurricanes – York County	117
Table 5.5.3	Historic Tornados – York County	118
Table 5.5.5a	Value of Exposed Structures from HAZUS®MH – York County	121
Table 5.5.5b	Summary of Probabilistic Analysis – Residential Structures – York County	122
Table 5.5.5c	Recent Winter Storms – York County	123
Table 5.5.5d	Critical Facilities at Risk – 100-Year Floodplain	124
Table 5.5.5e	Critical Facilities at Risk – Surge Zone Hurricane Category 4	125
Table 5.5.5f	Critical Facilities at Risk – High Wildfire Hazard Zone	126
Table 5.5.6	Capability Matrix – York County	127
Table 6.1.2a	Committee Voting Results on Mitigation Measures	148
Table 6.1.2b	Mitigation Measures Prioritized	149
Table 6.3	Categorizing Action Items by Goal and Objective	151

LIST OF FIGURES

		PAGE
Figure 2.0	Peninsula Vicinity Map	7
Figure 4.1.3	Significant Tropical Storm Systems, Virginia Peninsula	26
Figure 4.1.6	Virginia Lightning Strike Density Map for 1989 Only(State Climatology Office)	34
Figure 4.1.7	Winter Storm	34
Figure 4.1.8	Greatest Number of Consecutive 100°F Days	37
Figure 4.1.11	U.S. Drought Monitor, August 20, 2002	41
Figure 4.1.12	Virginia Peninsula Seismic Risk	42
Figure 4.1.13	National Lyme Disease Risk Map	49
Figure 5.6	Evacuation Zones	137

LIST OF APPENDICES

Appendix A	Hazard Mitigation Planning Committee Member List
Appendix B	Hazard Specific Mapping
Appendix C	Catalog of Virginia's Historical Hurricane
Appendix D	Hazard Ranking Sheets
Appendix E	Critical Facilities Inventory
Appendix F	Multi-Hazard Mapping – Large-Format Maps
Appendix G	Alternative Multi-Hazard Mitigation Actions
Appendix H	Criteria for Selecting Mitigation Measures
Appendix I	Public Meeting Notices and Community Resolutions of Adoption
Appendix J	Acronyms Used in This Plan
Appendix K	Public Comments and Response to Comments Memos
References	

1.0 Introduction

The Disaster Mitigation Act of 2000 (DMA 2000), approved by Congress and signed into law (Public Law 106-390) in October 2000, is a key component of the Federal government's attempt to reduce the rising cost of disasters in the United States. The Act establishes the Pre-Disaster Hazard Mitigation Program (PDM) and new requirements for the post-disaster Hazard Mitigation Grant Program (HMGP). It emphasizes the importance of mitigation planning in communities.

In an effort to highlight the importance of planning in the mitigation process, the DMA 2000 law requires local governments to develop and submit natural hazard mitigation plans in order to qualify for PDM and HMGP grant funding. Specifically, the Act requires that the plan demonstrate "a jurisdiction's commitment to reduce risk from natural hazards, serving as a guide for decision makers as they commit resources to reducing the effects of natural hazards." The final plan must be adopted by the jurisdiction and then approved by the Federal Emergency Management Agency (FEMA).

In order to facilitate DMA 2000 compliance for its member jurisdictions, the Peninsula Hazard Mitigation Planning Committee (PHMPC) developed a Natural Hazard Mitigation Plan pursuant to the requirements of DMA 2000. The Peninsula's hazard mitigation planning process also incorporated steps to meet the requirements of the Flood Mitigation Assistance (FMA) program, which will qualify its member jurisdictions for additional Federal flood mitigation assistance.

Hazard mitigation, defined, is any sustained action taken to reduce or eliminate long-term risk to human life and property from hazards. Planning is the process of setting goals, developing strategies, and outlining tasks and schedules to accomplish these goals. In preparing this plan, the PHMPC identified the natural hazards that threaten their jurisdictions, determined the likely impacts of those hazards, and assessed the vulnerability of the communities to the studied hazards. The PHMPC also assessed their capability to address those hazards through the existing programs and policies. The PHMPC then set mitigation goals and prioritized appropriate strategies to lessen the potential impacts of hazard events.

1.1 Scope

The Peninsula Natural Hazard Mitigation Plan identifies goals, information, and measures for hazard mitigation and risk reduction to make the participating communities more disaster-resistant and contribute to the planning area's long-term sustainability. The plan not only addresses current concerns, but has also been developed so it can be used to help guide and coordinate mitigation activities and local policy decisions for future land use.

This plan follows FEMA's DMA 2000 planning requirements and associated guidance for developing Local Hazard Mitigation Plans. The guidance sets forth a four-task mitigation planning process:

- organize resources,
- assess hazards and risks,
- develop a mitigation plan, and
- evaluate your work.

The plan also utilizes the criteria set forth in FEMA's Crosswalk Reference Document for Review and Submission of Local Mitigation Plans.

1.2 Plan Organization

The Peninsula Natural Hazard Mitigation Plan is organized into seven sections. The organization of the plan is as follows:

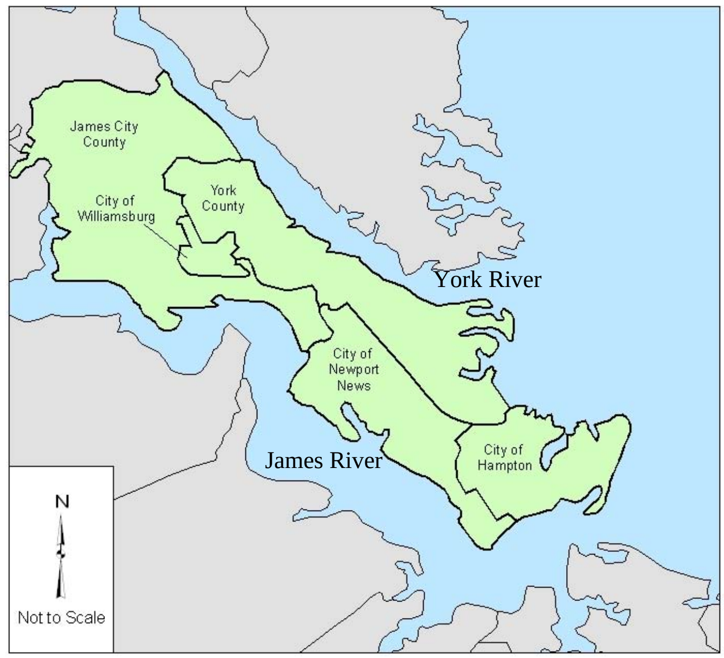
Table 1.2 -Plan Organization

Section Number	Title
1.0	Introduction
2.0	Regional Profile
3.0	Planning Process
4.0	Regional Hazard Identification and Risk Assessment
5.0	Community Specific Hazard Identification and Risk Assessment, including Regional and Community Capability Assessments 5.1 City of Hampton 5.2 City of Newport News 5.3 City of Williamsburg 5.4 James City County 5.5 York County
6.0	Regional Mitigation Goals and Objectives/Specific Community Actions 6.3.1 City of Hampton 6.3.2 City of Newport News 6.3.3 City of Williamsburg 6.3.4 James City County 6.3.5 York County
7.0	Plan Implementation and Maintenance

In the future, if communities wish to create a community-specific plan, appropriate sections can be utilized.

2.0 Regional Profile

Figure 2.0-Peninsula Vicinity Map



Location

The lower Virginia Peninsula in southeast Virginia is bounded by the York River, James River, and Chesapeake Bay. The region encompasses the independent cities of Hampton, Newport News and Williamsburg, and includes James City County and York County. The region has extensive natural areas, including the Chesapeake Bay, picturesque rivers, state parks, wildlife refuges, and botanical gardens.

This Peninsula is rich in colonial American history. The first permanent English settlement in North America was established in 1607 at Jamestown, in James City County. Virginia's first capital was in Williamsburg and much of the historic district of that city has been restored. Also, the decisive battle of the American Revolution, the Battle of Yorktown in 1781, took place on the Virginia Peninsula. In 1862 during the American Civil War, the Union Army invaded the Peninsula as part of the campaign to capture Richmond. The 1862 Battle of Yorktown took place along the York River.

The Peninsula jurisdictions are part of the Virginia Beach, Norfolk, Newport News, Virginia, North Carolina Metropolitan Statistical Area (MSA). The Virginia portion of this MSA is generally termed Hampton Roads. The land portion of Hampton Roads is divided into two regions: the Peninsula, on the north, and South Hampton Roads, on the south side, where the majority of the area's population resides.

Hampton Roads is an important area of water-based commerce, especially for the cities of Norfolk, Portsmouth, and Newport News. The Norfolk Naval Shipyard is located in Portsmouth a few miles up the Elizabeth River. Northrup Grumman Shipyard is located near the mouth of the James River in Newport News. There are also several smaller shipyards, numerous docks and terminals. Massive coal loading piers and facilities were established in the late 19th and early 20th century by the Chesapeake & Ohio (C&O), Norfolk & Western, and Virginian Railways at the end of the Peninsula in Newport News. CSX Transportation now serves the former C&O facility at Newport News.

Population Growth and Development Trends

Bordered by the York River to the north, James River to the south, Hampton Roads, and the Chesapeake Bay to the east, the Lower Virginia Peninsula is home to more than 450,000 people. (Weldon Cooper 2005) Future population projections indicate that the area will have more than 540,000 residents by 2030. (Virginia Employment Commission, 2005)

The Peninsula region has been one of Virginia's fastest growing regions in recent years. Between the 1990 and 2000 Census, the population of the region grew by 12.8 percent (see Table 2a). Population projections since the 2000 Census, completed by the Weldon Cooper Center for Public Service at the University of Virginia, show that the region as a whole continues to grow but at a less rapid pace.

Table 2a-Regional Population Statistics

Jurisdiction	Census Data		% change 1990 – 2000	Weldon-Cooper 2004 estimate [1]	% change 2000 to 2004	2030 Population Projection [2]
	1990	2000				
City of Hampton	133,793	146,437	9.5%	142,800	-2.48%	155,600
City of Newport News	170,045	180,150	5.9%	182,400	1.25%	190,100
City of Williamsburg	11,530	11,998	4.1%	13,600	13.35%	13,900
James City County	34,859	48,102	38.0%	55,200	14.76%	92,000
York County	42,434	56,297	32.6%	61,500	9.24%	91,000
Total	**392,649**	**442,984**	**12.8%**	**455,500**	**2.83%**	**542,600**

[1] Weldon Cooper Center, UVA 2005
[2] Virginia Employment Commission, Electronic Labor Market Access, 2005

In addition to population projections, the Weldon Cooper Center also summarizes building permits by community to provide a picture of residential construction activity by year. Building permits are categorized by type of building (single-family, 2-4 unit structures, and 5+ unit structures) and by builder-estimated value of construction. For multi-unit structures, the data indicate the number of units permitted rather than the number of buildings. The information excludes permits issued for mobile homes, garages and other out-buildings, additions and renovations, and commercial construction. These data provide insight to the amount of construction occurring in each of the team jurisdictions (see Table 2b).

Table 2b -2004 Annual Building Permit Data

Jurisdiction	Single Family Units		Structures with 2-4 Units		Structures with 5+ Units		Total Units	
	Number	Cost	Number	Cost	Number	Cost	Number	Cost
Hampton	321	$36,853,379	0	$0	0	$0	321	$36,853,379
Newport News	280	$33,347,101	0	$0	463	$26,793,361	743	$60,140,462
Williamsburg	93	$11,077,085	16	$1,090,400	0	$0	109	$12,167,485
James City	1,111	$239,382,070	0	$0	0	$0	1,111	$239,382,070
York	438	$73,474,329	36	$2,202,000	0	$0	474	$75,676,329
Total	2,243	$394,133,964	52	$3,292,400	463	$26,793,361	2,758	$424,219,725

2.1 History of the Peninsula Region

City of Hampton, Virginia

Hampton is the oldest continuously settled English-speaking community in the United States. The area now occupied by Hampton was first noted by English colonists before they sailed up the James River to settle in Jamestown, where they visited an Indian village called Kecoughtan.

In 1610 the construction of Fort Henry and Fort Charles at the mouth of Hampton Creek marked the beginnings of Hampton. In 1619, the settlers chose an English name for the community, Elizabeth City. The settlement was known as Hampton as early as 1680, and in 1705 Hampton was recognized as a town. The City of Hampton was first incorporated in 1849. In 1952, Hampton, the independent town of Phoebus and Elizabeth City County, encompassing Buckroe and Fox Hill, were consolidated under one municipal government.

Benjamin Syms and Thomas Eaton founded the first free public schools in the United States in Hampton. Hampton is the site of Hampton University, established in 1868 to educate freed slaves. St. John's Episcopal parish was founded in 1610, making it the oldest in the country.

Fort Monroe, the only active moat-encircled fort in the country, dates from 1819. For a long period during the Civil War, the fort was the only Union outpost in the Confederacy. The famous battle between the first ironclad battleships, the *Monitor* and the *Merrimac*, was fought just offshore in Hampton Roads, near the Hampton-Newport News municipal boundary.

During the Civil War, Hampton was burned down by its own troops rather than surrender to Federalist troops. Before the fire, Hampton had 30 businesses and over 100 homes. Fewer than six buildings remained intact after the fire. In 1884, fire again besieged Hampton and almost completely destroyed the downtown business district.

Hampton is now a thriving city with numerous industries including high-tech firms, seafood processing, NASA, military and tourism. Fort Monroe is currently headquarters for the U.S. Army Training and Doctrine Command but is facing closure and redevelopment as a result of the 2005 Base Realignment Closure Commission. Langley Air Force Base, where historic Langley field was constructed in 1917, is home of the First Fighter Wing. NASA Langley Research Center, where America's first astronauts were trained, is now a major center for aviation research.

City of Newport News, Virginia

Established as a town in 1880, Newport News was incorporated as a city in 1896. In the 1960s, the City of Newport News merged with Warwick County to create today's incorporated area.

The most widely accepted version of how Newport News was named relates to Captain Christopher Newport's return to the area from England in 1610. Newport met the Jamestown colonists on Mulberry Island, (located offshore on the James River) as they were preparing to return to England. The news of his arrival with three vessels, a plentiful supply of provisions and 150 men, gave heart to the dispirited colonists who agreed to go back to Jamestown. In gratitude, they named the point of landing "Newport's News." Over the years, the "s" was dropped, thus the name Newport News.

Newport News played a major role in the Peninsula Campaign during the Civil War. Numerous earthen fortifications and attractions that relate to the Civil War are still visible. Additionally, the famous Battle of the Ironclads took place off the shores of Newport News in 1862. Collis P. Huntington, a Northern railroad tycoon from Connecticut, established two major industries in Newport News: the Chesapeake and Ohio Railroad and Newport News Shipbuilding. Newport News Shipbuilding and Dry Dock Company, established in 1886, built many of the United States' aircraft carriers, including the *Enterprise*, *Kennedy*, *Washington*, *Vinson*, and *Roosevelt*. On Nov. 7, 2001, Newport News Shipbuilding signed a merger agreement with Northrop Grumman, and officially became Northrop Grumman Newport News.

The U.S. Army designated Newport News as a Port of Embarkation immediately after America's entry into World War I. The final major military base during WWI was Camp Eustis, which later became known as Fort Eustis. Named after the founder of Fort Monroe's Artillery School of Practice and a War of 1812 veteran, Brigadier General Abraham Eustis, the camp was created in 1918 to meet the need for an artillery firing range. Today, Fort Eustis is the home of the U.S. Army Transportation Corps, and the Transportation Corps Regiment. The U.S. Army Transportation Museum is also located at Fort Eustis.

City of Williamsburg, Virginia

In 1699, the General Assembly of Virginia established the City of Williamsburg as the colony's capital. The new city, formerly known as Middle Plantation, was named in honor of King William III. In 1722, King George I granted a royal charter incorporating the City of Williamsburg after the fashion of the English municipal borough.

During the 1700's, Williamsburg developed into a bustling capital city and played a singularly historic role in events leading to American Independence. In 1780, the capital of Virginia moved to Richmond, and the Williamsburg area reverted to a quiet college town and rural county seat. In retrospect, Williamsburg's loss of capital city status was its salvation. Many eighteenth century buildings survived into the early twentieth century, when John D. Rockefeller Jr. supported a massive restoration effort. Now, the center of tourism and history, the area is preserved and managed by “Colonial Williamsburg”, a non-profit foundation.

The College of William and Mary, located in Williamsburg, currently enrolls 5700 undergraduate and 2000 graduate students. Originally founded on February 8, 1693, William and Mary is the second-oldest institution of higher learning in the United States and the fourth oldest in North America. The school was one of the original Colonial colleges; the College's Wren Building is one of the oldest academic buildings in continuous use in the United States. The College educated several American leaders, including three U.S. Presidents. George Washington served as one of the College's first Chancellors.

William and Mary was occupied during the Civil War and closed from 1882-1888 due to financial strains (the College had invested in some Confederate bonds). In 1888, William and Mary reopened its doors and began to expand. Today, William and Mary is one of Virginia's most-cherished universities and was one of the first universities to become coeducational in 1918. William and Mary is consistently ranked among the premier public universities in America.

James City County, Virginia
On May 13, 1607, 144 English explorers arrived and soon established James Towne as the administrative center or capitol. In 1634, by order of the King of England, Charles I, eight shires or counties with a total population of approximately 5,000 inhabitants were established in the colony of Virginia. James City Shire, as well as the James River and Jamestown took their name from King James I, the father of King Charles I. About 1642-43, the name of the James City Shire was changed to James City County. The original county included what is now Surry County across the James River, part of Charles City County and some of New Kent County.

Williamsburg became an independent city from James City County in 1884; however, the city is still the county seat of James City County, and they share a school system, courts, and some constitutional officers.

James City County encompasses land important in the early history of our nation. Three jurisdictions, James City County, York County, and the City of Williamsburg, work collaboratively on policies, programs, infrastructure and land use to preserve this historic area.

York County, Virginia
York County, named for King Charles I, was formed in 1634 as Charles River Shire. It was one of the eight original shires in the Colony of Virginia. The county was renamed in 1642-43 as York County. The river, county, and town are believed to have been named for York, a city in Northern England. The first courthouse and jail were located near what is now Yorktown, although the port used for shipping tobacco to Europe was variously called Port of York, Borough of York, York, or Town of York, until Yorktown was established in 1691. Never incorporated as a town, Yorktown is the county seat of York County. The only town ever incorporated within the county's boundaries was Poquoson, which was incorporated in 1952 and became an independent city in 1975.

York County is most famous as the site of the surrender of General Cornwallis to General George Washington in 1781, ending the American Revolutionary War. Yorktown also figured prominently in the Civil War, serving as a major port to supply both northern and southern towns, depending upon who held Yorktown at the time.

Yorktown is part of an important national resource known as the Historic Triangle of Yorktown, Jamestown and Williamsburg, and is the northern terminus of the Colonial Parkway.

3.0 Planning Process

The Peninsula Group retained AMEC Earth & Environmental (AMEC) to assist with the facilitation and development of the region's Multi-Jurisdictional Mitigation Plan. AMEC assisted the region with the following tasks and processes:

- Establishment of the Peninsula Hazard Mitigation Planning Committee (PHMPC),
- Meeting all of the DMA and FMA requirements as established by federal regulations and in accordance with FEMA's planning guidance,
- Facilitation of the planning process,
- Identification of the data requirements and conduct of the research and documentation necessary to augment that data,
- Development and facilitation of the public input process,
- Production of the draft and final plan documents, and
- Submission for acceptance by the Virginia Department of Emergency Management (VDEM) and FEMA Region III.

AMEC assisted the PHMPC with the establishment of the process for this planning effort utilizing the DMA 2000 planning requirements, and FEMA's associated guidance. In addition, AMEC's planning process also incorporated another 10-step planning process that satisfies the planning requirements of several other federal programs, including the U.S. Army Corps of Engineers' Floodplain Management Planning, the Community Rating System (CRS) of the National Flood Insurance Program (NFIP), and FEMA's FMA program. The approach for these programs follow the steps shown Table 3 juxtaposed with the DMA 2000 requirements. The PHMPC followed this process in developing this plan.

Disaster Mitigation Act Planning Regulations (44 *CFR* 201.6)	**CRS / FMA Planning Steps**
Planning Process	
201.6(c)(1)	1. Organize
201.6(b)(1)	2. Involve the public
201.6(b)(2) & (3)	3. Coordinate
Risk Assessment	
201.6(c)(2)(i)	4. Assess the hazard
201.6(c)(2)(ii) & (iii)	5. Assess the problem
Mitigation Strategy	
201.6(c)(3)(i)	6. Set goals
201.6(c)(3)(ii)	7. Review possible activities
201.6(c)(3)(iii)	8. Draft an action plan
Plan Maintenance	
201.6(c)(5)	9. Adopt the plan
201.6(c)(4)	10. Implement, evaluate, revise

Table 3a- DMA 2000/CRS Planning Requirements

Local Government / Community Participation

The DMA planning regulations and guidance stress that each local government seeking the required FEMA approval of their mitigation plan must:

- Participate in the process,
- Detail areas within the Planning Area where the risk differs from that facing the entire area,
- Identify specific projects eligible for funding, and
- Have the governing boards adopt the plan.

To help define the participation process in this plan, the PHMPC further defined participation as:

- Attendance at the Hazard Mitigation Planning Committee meetings,
- Providing data that was requested by the Planning Committee,

- Reviewing and providing comments on draft plans,
- Advertising, coordinating, and participating in the Public Input elements, and
- Coordination of plan adoption by the individual communities.

The following pages describe the planning process in further detail.

Table 3b -PHMPC Meeting Focus

PHMPC Mtg. #	Date	Meeting Focus
1	10-28-04	Kick-off: plan purpose and scope, planning process explanation, role of participating communities, PHMPC composition, public input strategy, and coordination with other agencies, stakeholders, and community plans. 35 members attended. Held in James City County.
2	12-07-04	Reviewed data collection methods and requirements for HIRA and Capability Assessment, conducted prioritization of hazards exercise for each community; 40 members attended. Held in Newport News.
3	02-01-05	Reviewed Draft #1, marked up large format maps w/problem areas, reviewed and established goals and objectives through "card-storming," 35 members attended. Held in Williamsburg.
4	03-01-05	Reviewed goals and objectives, reviewed/discussed alternative mitigation measures, brainstormed recommended mitigation measures from alternatives. 29 members attended. Held in York County
5	03-02-05	Reviewed mitigation measure selection criteria, prioritized mitigation measures using criteria (and "dot" voting system), developed detailed mitigation recommendations with scheduling information, funding sources, and detailed problem descriptions. 25 HMPC members attended. Held in Hampton.
6	06-22-05	Distributed hard copies of the Draft #2; reviewed Recommended Action Plans for each community and discussed each with PHMPC; reviewed schedule and planned next set of Public Meetings, reviewed of multi-hazard mapping (large format); and discussed adoption process. 24 members attended. Held in Hampton
7	10-18-05	Review of Public & PHMPC comments from Draft #3

Step 1: Get Organized – Building the Planning Team

The PHMPC was comprised of key Peninsula and local stakeholder representatives. The Deputy Coordinator of the Office of Emergency Management of the City of Newport News led the team. The first step was to establish both a framework and organization for the development of this Plan. The Committee met seven times over a one-year period. Typical attendees at each meeting included representatives from the police, fire, planning, public works, utilities, emergency management, school system and finance departments, as well as VDEM. A list of Committee members is included in Appendix A. Invitees, attendance and agendas for each of the Committee meetings are on file at the Newport News Emergency Management office in the City of Newport News. The Committee will remain intact for the purpose of implementing and updating this plan.

Step 2: Plan for Public Involvement – Engaging the Public

An open public planning process was utilized that provided opportunities for the public and stakeholders to comment on the plan at all stages of its formation. At the first PHMPC Meeting in November 2004, the plan for public involvement was discussed and agreed upon. Committee meeting schedules, minutes, and plan updates were posted on each of the community's web pages at www.hampton.gov/eoc, www.newportnews.va.us/eoc/index.htm, http://www.james-city.va.us/, www.yorkcounty.gov/, www.ci.williamsburg.va.us/. All articles, press releases and Internet postings are on file with the City of Newport News Office of Emergency Management.

Table 3c –Public Input Meeting Dates

Public Meeting #	Date	Location
1	02-16-05	James City County
2	02-17-05	York County
3	02-28-05	Hampton
4	06-22-05	Newport News
5	06-27-05	James City County
6	06-23-05	Hampton
7	11-1-05	Williamsburg
8	11-2-05	York County
9	11-3-05	Newport News

A series of nine public meetings, spread across the various jurisdictions, were held to take comments on the draft hazard mitigation plan. Numerous press releases were provided, as well. The first releases coincided with the presentation to the public of the draft plans, and the last coincided with the announcement of the adoption of the plan by all the communities involved in the process.

Step 3: Coordinate with other Departments and Agencies

Early in the planning process, the Committee determined that the participation of other state and federal agencies would be beneficial in the data collection, mitigation and action strategy development, and plan approval process. Representatives from the following key agencies and local military instillations were invited to participate on the Committee:

- Virginia Department of Conservation and Recreation (VDCR),
- Virginia Department of Emergency Management Region 5 (Mitigation Planning Division),
- Coast Guard Training Center Yorktown,
- FEMA Region III (Mitigation Planning Division),
- Fort Eustis,
- Fort Monroe,
- Langley Air Force Base,
- National Weather Service (Wakefield Office), and
- Naval Weapons Station Yorktown.

Project managers invited representatives from Hampton University, Thomas Nelson Community College, the College of William & Mary, and the Southeast Community Redevelopment Office. Businesses were invited to participate in the team planning process through an invite extended to the Peninsula Chamber of Commerce. Non-profits were included through the public comment periods and notifications in local newspapers. Letters of invitation for each of the Committee meetings are on file at the Newport News Emergency Management office.

In addition to the agencies listed above, the Committee used the resources of the agencies set forth below in the development of this plan. Specifically, technical data, reports, and studies were obtained from these agencies either through web-based resources or directly from the agencies themselves:

- Virginia Department of Conservation and Recreation (DCR),
- Virginia Department of Emergency Management (VDEM),
- Virginia Department of Forestry (VDOF),
- Virginia Department of Health (VDH),
- Virginia Department of Mines, Minerals, and Energy,
- Virginia Soil and Water Conservation (VS&WC),
- Federal Emergency Management Agency (FEMA),
- National Oceanic and Atmospheric Association (NOAA),
    - National Climatic Data Center (NCDC),
    - National Weather Service (NWS), and
- U.S. Geological Survey (USGS).

Relationship to Other Community Planning Efforts and Hazard Mitigation Activities
Coordination with other community planning efforts is paramount to the success of a hazard mitigation plan. Hazard mitigation planning involves identifying existing community policies, tools, and actions that will reduce a community's risk and vulnerability to natural hazards. The Committee identified a variety of comprehensive planning mechanisms such as land use or master plans, emergency response plans, mitigation plans, municipal ordinances and building codes that guide and control community development. Cross-referencing existing planning efforts, mitigation policies, and action strategies into this Hazard Mitigation Plan links the specific natural hazards that present a risk to the community with the existing mitigation elements found in other community programs, other planning documents, and regulations. The development of this plan utilized information included in the following community plans, studies, reports, and initiatives:

- Municipal Comprehensive Plans from Peninsula area localities,
- Codified Ordinances from Peninsula area localities,
- Virginia Uniform Statewide Building Code – 2000,
- 2003 Hurricane Isabel Damage Assessment Reports,
- Peninsula area Tax Assessor and Land Use data, and
- Flood Insurance Study and Flood Insurance Rate Maps for the Peninsula region.

Through implementation of this plan appropriate data and recommendations of this plan will be integrated into the other existing community activities.

The following sections of this plan complete the ten-step planning process;

- Section 4.0- Hazard Identification and Risk Assessment is step 4: Assess Hazard
- Section 5.0-Community Specific Profiles is step 5: Assess the Problem
- Section 6.0-Mitigation Goals and Objectives are Step 6: Set Goals, Step 7: Review Possible Activities, and Step 8: The Action Plan.
- Section 7.0-Plan Implementation includes Step 9: Plan Implementation and Step 10: Plan Maintenance

4.0 Hazard Identification and Risk Assessment

This section of the plan includes a summary discussion of natural hazards that could potentially impact the Peninsula region. General hazard histories and vulnerability across the entire region, for both critical and non-critical hazards, are discussed with minimal reference to individual communities. For the purposes of mitigation planning, critical hazards are defined as those hazards for which historical data exists to document impacts that have resulted in losses to the community and its' citizens. Non-critical hazards are hazards that have occurred very infrequently or have not occurred at all in the historical data. Non-critical hazards are not considered a widespread threat resulting in significant losses of property or life. Hazard losses, historical data, and some anecdotal evidence of severity are included in this section.

Section 5 furthers the risk assessment by providing a more detailed community-specific evaluation of the critical hazards and their potential impact. Each community's risk assessment contains a summary of historical information on natural hazard losses and a detailed vulnerability assessment. The vulnerability assessment uses data available in the communities to define the hazard in terms of a metric. In this case, the metric used are the assets at risk by dollar value as established by local property assessments. The vulnerability of critical facilities is also provided. FEMA defines critical facilities as those facilities that warrant special attention in preparing for a disaster, and/or facilities that are of vital importance to maintaining citizen life, health, and safety during and/or directly after a disaster event. A final component of the risk assessment is capability assessment of existing programs and mechanisms in place to mitigate the effects of natural hazards completes the overall risk assessment. This helps determine appropriate mitigation actions by taking into account those measures that already exist.

In summary, Sections 4 and 5 identify hazards that have potential to adversely affect the jurisdictions. By quantifying potential impacts through the vulnerability analyses, and outlining existing protective measures that lessen those impacts through the capability analysis, a net vulnerability is determined. The plan's goals and objectives are then based on this net vulnerability.

4.1 Hazard Identification

The PHMPC for the Peninsula conducted a Hazard Identification study to determine which hazards threaten the planning area communities. The natural hazards identified and investigated in the Peninsula region included the following:

- Flooding
- Hurricanes & Tropical Storms
- Tornados
- Nor'easters
- Thunderstorms
- Winter Storms
- Extreme Heat
- Dam Failure
- Wildfire
- Drought
- Earthquakes
- Biological Hazards/Epidemics
- Landslides
- Expansive Soils
- Tsunamis

Historical data was collected for all hazard types. By examining the historical occurrence of each hazard, along with the impacts, the PHMPC was able to identify the critical hazards; those that pose the most significant risks to the region. This allowed the PHMPC to focus its mitigation planning efforts on those critical hazards. Prioritizing the potential natural hazards that threaten the Peninsula area required analysis of two factors: the probability that a certain type of natural hazard will affect the region and the potential extent and severity of the damage caused by that hazard. The probability of occurrence for each hazard was determined using existing technical analyses, such as the FEMA Flood Insurance Study. When data was not available, the probability was based on the history of events.

There have been 34 presidential disaster declarations in Virginia between 1953 and September 2005 (Table 4.1) with eight having direct impacts on the Peninsula.

Table 4.1 -Presidential Disaster Declarations in Virginia, 1953 –2005

Declaration Number	Month	Year	Description	Impacted Peninsula
274	**August**	**1969**	Hurricane Camille (flooding); 27 jurisdictions declared, but none on the Peninsula	
339	**June**	**1972**	Hurricane Agnes (flooding); 106 jurisdictions declared	✓
358	**September**	**1972**	Storm/Flood; Hampton and Newport News declared	✓
359	**October**	**1972**	Flood; Western, Central, Southeastern Virginia; 31 jurisdictions declared	
531	**April**	**1977**	Flash Flood; Southwestern Virginia; 16 jurisdictions declared	
543	**November**	**1977**	Flood; Southwestern Virginia; 8 jurisdictions declared	
593	**July**	**1979**	Flood; Buchanan County declared	
606	**September**	**1979**	Flood; Patrick County declared	
707	**May**	**1984**	Flood; Buchanan, Dickinson & Washington Counties declared	
755	**November**	**1985**	Flood; Western, Central Virginia; 52 jurisdictions declared	
847	**October**	**1989**	Flood; Buchanan County declared	
944	**April**	**1992**	Flood; Western Virginia; 24 jurisdictions declared	

Declaration Number	Month	Year	Description	Impacted Peninsula
1007	**December**	**1993**	Severe Storm; Tornado	
1014	**February**	**1994**	Ice Storm; Central, Western Virginia; 71 jurisdictions declared	
1021	**March**	**1994**	Ice Storm; Central, Western Virginia; 29 jurisdictions declared	
1059	**June**	**1995**	Flood; Central & Western Virginia; 24 jurisdictions declared	
1086	**January**	**1996**	Blizzard; all counties and cities in state declared.	✓
1098	**January**	**1996**	Flood; 27 jurisdictions declared	
1135	**September**	**1996**	Hurricane Fran (flooding); 88 jurisdictions declared	
1242	**August**	**1998**	Hurricane Bonnie (flooding); 5 jurisdictions declared	
1290	**September**	**1999**	Hurricane Dennis; Hampton declared	✓
1293	**September**	**1999**	Hurricane Floyd (flooding); 48 jurisdictions declared, including Peninsula communities	✓
1318	**February**	**2000**	Winter Storms; 107 jurisdictions declared, including Williamsburg, JCC and York Co	✓
1386	**July**	**2001**	Flood; Southwestern Virginia; 10 jurisdictions declared	
1392	**September**	**2001**	Pentagon Attack; 1 jurisdiction declared	
1406	**March**	**2002**	Flood; Southwestern Virginia; 10 jurisdictions declared	
1411	**April/May**	**2002**	Flood; Southwestern Virginia; 9 jurisdictions declared	
1458	**February**	**2003**	Winter Storms/Flooding; 39 jurisdictions declared	
1491	**September**	**2003**	Hurricane Isabel (winds, flooding); 100 jurisdictions declared, including Peninsula communities	✓
1502	**November**	**2003**	Flood; Southwestern Virginia; 6 jurisdictions declared	
1525	**May**	**2004**	Flood; Southwestern Virginia; 3 jurisdictions declared	
1544	**September**	**2004**	Flood; Central Virginia; 12 jurisdictions declared	
1570	**October**	**2004**	Flood; Southwestern Virginia; 10 jurisdictions declared	
3240	**September**	**2005**	Hurricane Katrina Evacuation; all Peninsula communities declared	✓

Source: VDEM and FEMA web sites.

4.1.1 Multi-Hazard Correlation

While this plan investigates individual hazard history and occurrence, it should be noted that many hazards occur simultaneously or in sequences that result in other subsequent hazards. For example, hurricanes are defined by sustained wind speed but not all hurricane damage is from wind. Heavy rains associated with these storms and storm surge generated by waters piled up on shore result in devastating flooding. The effects of natural hazards can last years after the initial damage events. High wind events blow down trees, which can increase the wildfire hazard for years to come due to an increase in downed dead or dying woody debris. In addition, uprooted trees in low-lying or typically damp areas can cause other problems. For example, the root bulb from the fallen tree can excavate large holes in the landscape, which when filled the rainwater can provide breeding grounds for mosquitoes. Another example would be the clogging of drainageways and culverts by the fallen trees.

Although the effects of storm surge can be the most devastating of a tropical system, storm surge is unlikely to occur without the existence of a tropical storm or hurricane. Therefore, storm surge is discussed below as a secondary hazard associated with tropical systems. Erosion in the Peninsula region is typically associated with nor'easters and can also be a secondary effect of sea level rise. Additional detail on the erosion hazard is included in the nor'easter and sea level rise descriptions below.

4.1.2 Flooding

Flooding is the most frequent and costly natural hazard in the United States. Approximately 80 percent of presidential disaster declarations result from natural events in which flooding is a major component. Excess water from snowmelt, rainfall, or storm surge accumulates and overflows onto adjacent floodplains—lowlands adjacent to rivers, lakes, and oceans that are subject to recurring floods. While many floodplain boundaries are mapped by FEMA's National Flood Insurance Program (NFIP), floods sometimes go beyond the mapped floodplains or change courses due to natural processes (e.g., accretion, erosion, sedimentation) or human development (e.g., filling in floodplain or floodway areas, increased imperviousness within the watershed from new development, or waterway blockage from debris including: trees, cars, trailers, and propane tanks).

There are four types of flooding in Virginia: coastal flooding, urban flooding, flash flooding, and river flooding. Due to its geographic location within the coastal plain and its rapid population growth, the Peninsula area is susceptible to all four types of flooding.

Coastal Flooding
Coastal flooding (or tidal flooding) results from higher than average tides along coastal areas. This usually occurs during passing tropical systems and nor'easters. The high winds produced by these events can pile water on the shorelines. If this occurs at the time of the astronomical high tide, the flooding is amplified and will inundate low-lying areas along the shorelines.

Urban Flooding
Urban flooding occurs in heavily developed areas where impervious surfaces do not allow water to be absorbed into the ground, thereby increasing the amount of water runoff. If areas are without proper drainage, or storm drains become clogged, then streets become streams and water will gather in low-lying areas. If it rains hard enough, underpasses can rapidly fill, trapping

motorists. Streets can accumulate enough water to submerge cars or carry them wherever the water flows.

Flash Flooding

Flash floods occur in a short period of time, or in a "flash". Rain falls at such a high rate that water does not have time to soak into the ground. Runoff flows downhill into ditches, lowlands and small streams. As the heavy rain continues, ditches overflow, drains backup, water ponds in lowlands, and streams rise over their banks. Streams and creeks can become raging rivers in just minutes. People are often caught off guard, especially motorists. Half of flash flood deaths in the United States are in automobiles.

River Flooding

River floods occur when heavy rains fall over a large area. In many cases in Virginia, it begins as widespread flash flooding of small streams. About 60 percent of Virginia's river floods begin with flash flooding from tropical systems passing over or near the state. River flooding also occurs as a result of successive rainstorms. Rainfall from any one storm is generally not enough to cause a problem, but with each successive storm's passage over the basin, the river rises until eventually it overflows its banks. If it is late winter or spring, melting snow in the mountains can produce added runoff that can compound flood problems.

Frequent flash flooding and urban flooding on the Peninsula is often caused by powerful thunderstorms that can dump one to four inches of rain in a few hours. Small creeks and streams as well as over-burdened drainage systems often cannot cope with the rapid influx of rain waters, especially when runoff is increased through urbanization of the watershed, or poor infiltration of precipitation due to overly wet or dry soils. The banks of non-tidal streams may quickly overtop, resulting in flooded roads and intersections and occasional property damage. The topography of much of the Peninsula is relatively flat and low-lying, which further hinders effective disbursement of runoff. Additional discussion regarding urban flooding and specific problem areas is included in Section 5 through detailed descriptions for each community.

4.1.3 Hurricanes and Tropical Storms

A hurricane is a type of low-pressure system, which generally forms in the tropics; similarly, a tropical storm is a low-pressure system of less intensity than a hurricane. Tropical systems are an important part of the atmospheric circulation system, distributing heat from the equatorial region to the higher latitudes. Hurricane season in the North Atlantic generally runs from June 1st until November 30th, with the peak season between August 15th and October 15th. Winds of a hurricane blow in a large, counter-clockwise spiral around a relatively calm center of extremely low pressure known as the eye. Around the rim of the eye, winds are most intense and may gust to more than 200 mph in a very strong storm.

Once a hurricane has formed, they maintain themselves by extracting heat energy from the ocean at high temperatures and releasing heat at the low temperatures of the upper troposphere. Hurricanes and tropical storms are violent systems that bring heavy rainfall, storm surge, high winds and may spawn tornados, all of which can cause significant damage. These storms can last for several days; however, the average hurricane duration is 12 to 18 hours. The duration and vast area impacted create the potential for sustained flooding, high wind, and erosion conditions across several states. While wind speeds can be expected to reduce by 50 percent within 12 hours of landfall, these storms are capable of producing a large amount of rain in a short period over a wide area.

Residents and emergency managers on the Peninsula are particularly interested in the track of any approaching storm. Proximity, direction, and strength are important factors when determining response measures, evacuation needs, and potential damage from the storm. When hurricanes approach land, forecasters often describe them as having four distinct quadrants: right-front, right-rear, left-front, and left-rear. The quadrants are relative to the hurricane's overall direction of motion and are significant in evaluating damage potential. The right-front quadrant generally causes the most destruction at the coast because the winds have an additive effect of sustained on-shore winds plus the motion of the hurricane. Onshore winds are strongest in the right-front quadrant; therefore, the surge and waves in that section are also the highest.

In 1971, wind engineer Herbert Saffir and hurricane expert Dr. Robert Simpson developed a scale to classify hurricanes. The Saffir-Simpson scale rates the intensity of hurricanes based on wind speed and barometric pressure measurements. The National Weather Service uses the scale to predict potential property damage and flooding levels from imminent storms. Although the scale assigns a wind speed and surge level to each category of storm, in recent years, there has been more and more recognition of the fact that wind speed, storm surge and inland rainfall are not necessarily of the same intensity for a given storm. Therefore, there is some interest in classifying hurricanes by separate scales according to each of these risks. However, the Saffir-Simpson Scale is still the most widely used classification tool for hurricanes. The scale is outlined in Table 4.1.3. Over time, researchers and meteorologists have further refined the analysis of the wind damage that hurricanes can produce by differentiating the concept of sustained winds from peak gusts. Sustained winds are measured over longer periods of time, typically a minute. A peak gust is the highest 2 to 5 second wind speed.

Table 4.1.3-Saffir-Sampson Scale

Category	Sustained Wind Speeds (mph)	Tidal Surge (ft)	Pressure (mb)	Typical Damage
Tropical Depression	<39	--	--	
Tropical Storm	39-73	--	--	
Hurricane Category 1	74-95	4-5	> 980	*Minimal* – Damage is done primarily to shrubbery and trees, unanchored manufactured homes are damaged, some signs are damaged, no real damage is done to structures on permanent foundations.
Hurricane Category 2	96-110	6-8	965-980	*Moderate* – Some trees are toppled, some roof coverings are damaged, major damage is done to manufactured homes.
Hurricane Category 3	111-130	9-12	945-965	*Extensive Damage* – Large trees are toppled, some structural damage is done to roofs, manufactured homes are destroyed, and structural damage is done to small homes and utility buildings.
Hurricane Category 4	131-155	13-18	920-945	*Extreme Damage* – Extensive damage is done to roofs, windows, and doors, roof systems on small buildings completely fail, some curtain walls fail.
Hurricane Category 5	> 155	> 18	< 920	*Catastrophic Damage* – Roof damage is considerable and widespread, window and door damage is severe, there are extensive glass failures, some buildings fail completely.

Storm Surge

The communities involved in this planning effort are particularly exposed to the high winds and storm surge associated with hurricanes due to the coastal topography and the large bodies of water surrounding the Peninsula. The greatest potential for loss of life related to a hurricane is from the storm surge. Storm surge is simply water that is pushed toward the shore by the force of the winds swirling around the storm. This advancing surge combines with the normal tides to create the hurricane storm tide, which can increase the mean water level 15 feet or more. In addition, wind waves are superimposed on the storm tide. This rise in water level can cause severe flooding on the Peninsula, particularly when the storm tide coincides with the normal high tides.

Surge maps for York County, the City of Hampton and Newport News are included in Appendix F. Surge maps for James City County are under development by United States Army Corps of Engineers (USACE). The City of Williamsburg is not considered susceptible to storm surge flooding. A surge map can provide a great deal of information if the reader understands how the maps were prepared and their intended use.

Surge maps are based upon a Sea, Lake and Overland Surges from Hurricanes (SLOSH) model and are the basis for the "hazard analysis" portion of the area's hurricane evacuation plans. SLOSH is a computerized model run by the National Hurricane Center (NHC) to estimate storm surge heights and winds resulting from historical, hypothetical, or predicted hurricanes by taking into account: pressure, size, forward speed, track, and winds.

Hundreds of hypothetical hurricanes are simulated with various Saffir-Simpson categories, forward speeds, landfall directions, and landfall locations. An envelope of high water containing the maximum value a grid cell attains is generated at the end of each model run. These envelopes are combined by the NHC into various composites which depict the possible flooding. One useful composite is the MEOW (Maximum Envelopes of Water) which incorporates all the envelopes for a particular category, speed, and landfall direction. Another composite that is useful to emergency managers is the MOM (Maximum of the MEOWs), which combines all the MEOWs of a particular category.

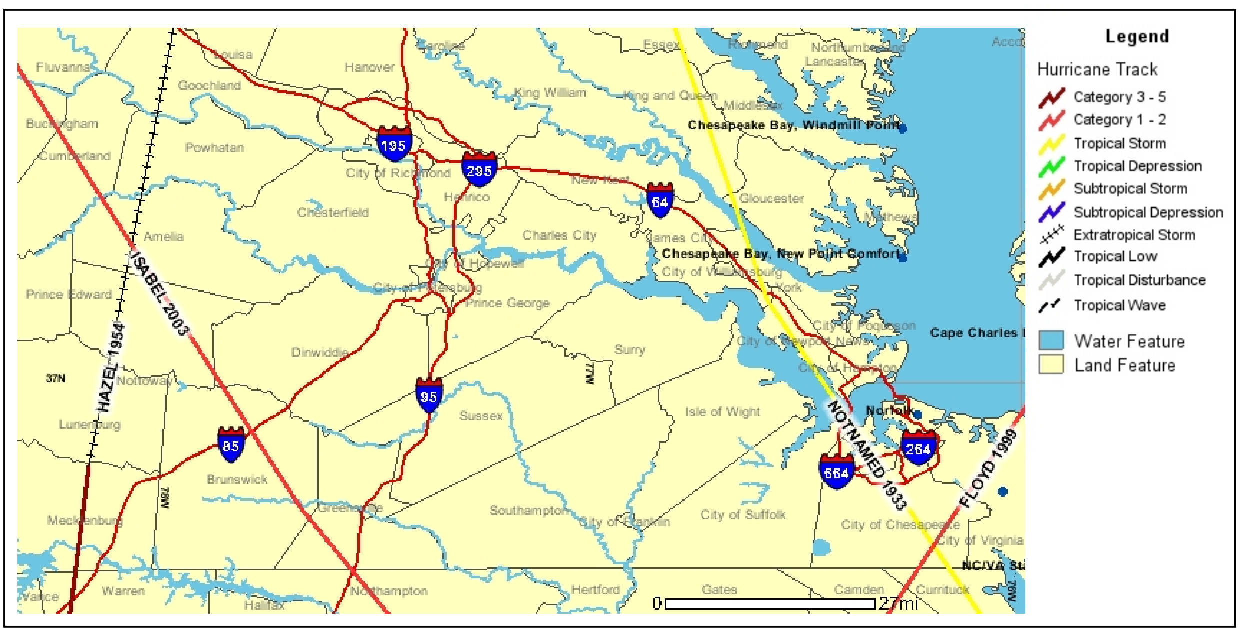
To provide some tools to emergency managers, regional evacuation studies have been completed using the SLOSH models. The MEOW maps are produced for all five levels of hurricane intensity and for many directions of storm motion, and they depict the "worse case" scenario for all categories of storms and all potential storm tracks. MEOW maps are just one tool an emergency manager will use to determine risk areas and evacuation recommendations.

The MOM (Maximum of MEOWs) storm surge maps for the Peninsula depict the "worst of the worst", and not the results of any one storm. There are no surge heights for Category Five storms because the region is generally not conducive to storms of that intensity.

History of Tropical Systems

Since 1851, 34 tropical systems have passed within 25 nautical miles of the Peninsula (see Appendix B). The Hurricane Maps and tables provided in Appendix B provide tracks and meteorological data for each of these systems. Additionally, Appendix C provides a more comprehensive set of information on individual storm events and the impacts to the Virginia coastal region as a whole. Data were obtained from a variety of sources as referenced in Appendix C. Community-specific damage information for hurricanes is provided in Section 5.

Figure 4.1.3 -Significant Tropical Storm Systems, Virginia Peninsula



Source: NOAA CSC Hurricane Mapping Tool

Figure 4.1.3 indicates the paths of particularly noteworthy tropical systems for Peninsula communities, except the 1749 storm described below. The list of noteworthy storms includes:

- **October 19, 1749,** a tremendous hurricane created Willoughby Spit, south of Hampton. The Bay rose 15 feet above normal. In Williamsburg, a family drowned as flood waters carried their house away. At Hampton, water rose to four feet deep in the streets; many trees were uprooted or snapped in two. Bodies washed ashore from shipwrecks for days afterward. Hurricane wiped out Ft. Monroe's predecessor, Ft. George.

- **Chesapeake-Potomac Hurricane, August 23, 1933,** established record high tides in many locations; approximately 9.8 feet above mean lower low water. There were four casualties on the Peninsula: two in Hampton, one in James City County, and one in York County. At Buckroe Beach in Hampton, and at Yorktown, marshal law was declared and National Guard troops were brought in to prevent looting. Flooding was severe in low-lying parts of Hampton (Fox Hill and Buckroe), York County (Goodwin Neck), and Newport News (Small Boat Basin). Jamestown Island was severely damaged.

- **Hurricane Hazel, October 15, 1954,** inflicted 130mph winds on Hampton and blew apart at least one anemometer there. There was one casualty on the Peninsula in the Dare section of York County.

- **Hurricane Floyd, September 6, 1999,** passed directly over Virginia Beach as a Category 1 Hurricane. Rainfall amounts in areas west of the Peninsula reached staggering amounts in excess of 15 inches. Prior rainfall created wet conditions that led to flooding in some parts of Newport News and Hampton.

- **Hurricane Isabel, September 18, 2003**, made landfall near Ocracoke, North Carolina as a Category 2 hurricane, and the center passed west of Emporia. Isabel brought hurricane conditions to the Peninsula and caused significant flooding, with highest tide at Sewells Point of 7.9 feet above mean lower low water, a 5 foot storm surge. There was significant beach and shore erosion along much of the Peninsula's shoreline. Grandview and Buckroe areas of Hampton, Newport News/James River waterfront, Seaford area of York County and Yorktown waterfront had many structures severely damaged by storm surge. On the Peninsula, Isabel indirectly caused one drowning death in Newport News and one debris cleanup accident fatality in York County. Statewide, the storm resulted in $1.6 billion in damages with over 1,186 homes and 77 businesses completely destroyed, 9,110 homes and 333 businesses with major damage, and over 107,000 homes and 1,000 businesses with minor damage. Hundreds of power lines were blown down leaving almost two million electrical customers without power. Crop losses were calculated to be $59.3 million with another $57.6 million in damages to farming infrastructure.

4.1.4 Tornados

Tornados are one of nature's most violent storms. A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud, circulating in a counterclockwise direction.

Tornados are spawned by a thunderstorm (sometimes as part of a hurricane) and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. The damage from a tornado is a result of the high wind velocity and wind-blown debris. Tornado season is generally March through August, although tornados can occur at any time of year. They tend to occur in the afternoons and evenings; over 80 percent of all tornados strike between noon and midnight. Tornados generally travel along squall lines, in a direction from southwest to northeast.

In an average year, about 1,000 tornados are reported across the United States, resulting in 80 deaths and over 1,500 injuries. The most violent tornados are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of one mile wide and 50 miles long. A tornado's destructive power is measured using the Fujita Damage Scale (See Table 4.1.4a). A tornado's intense power often destroys homes, downs power lines, and can cause significant tree damage.

Table 4.1.4a -Fujita Damage scale

Scale	Wind Estimate (mph)	Typical Damage
F0	< 73	Light Damage Some damage to chimneys; branches off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate Damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable Damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe Damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating Damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.
F6	319-379 mph	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies

Source: Fujita, 1971.

Most tornados on the Peninsula have occurred from June through October, and the magnitudes range from F0 to F3. The most significant tornado to strike the Peninsula in recent history was an F3 tornado in Newport News on September 5, 1979. The tornado cut a path 50 yards wide and 3 miles in length, and caused an estimated $2.5 million in property damage. In addition to tornados over land, Peninsula residents are also subject to more common waterspouts, or tornados over water. The interaction of cool coastal breezes and warm air masses over land create ideal tornado conditions when thunderstorms move over this boundary (Watson 2004c).

The tornado history compiled for Table 4.1.4b provides information on Peninsula tornados that caused significant damage, and was compiled from the NCDC database and Watson (2004b). The list begins with a storm in 1951. Quite obviously, tornados occurred on the Peninsula before 1951, but records of these storms were not readily available for the purposes of this plan. As with lighting strikes, if there is no sighting or confirmation of a tornado, inclusion in the body of tornado statistics is not likely, so this table should not be considered an all-inclusive list of tornados impacting the Peninsula.

Table 4.1.4b -Significant Historical Tornados Impacting the Peninsula

Community	Date	Magnitude	Deaths	Injuries	Property Damage	Crop Damage	Associated Tropical Cyclone?
Newport News	June 27, 1951	F1	0	0	$3K	0	No
York County	November 1, 1951	F1	0	0	$3K	0	No
Newport News	April 6, 1958	F1	0	0	$250K	0	No
Newport News	October 7, 1965	F0	0	0	$3K	0	No
Newport News	September 5, 1979	F3	0	2	$2.5M	0	Yes, David
Hampton	September 5, 1979	F2	0	9	$250K	0	Yes, David
Newport News	June 1, 1982	F0	0	0	$0K	0	No
Hampton & Newport News	August 6, 1993	F1	0	10	$5.0M	0	No
York County	July 12, 1996	F1	0	0	$15K	0	Yes, Bertha
Hampton	September 4, 1996	F0	0	0	$1K	0	Yes, Fran
Hampton	September 4, 1999	F2	0	6	$7.7M	0	Yes, Dennis
Newport News	August 11, 2001	F0	0	0	$50K	0	No
York County	August 7, 2003	F1	0	0	$20K	0	No
Hampton	August 30, 2004	Not reported	0	0	Not reported	0	Yes, Gaston

Sources: NCDC and Watson 2004b.

Appendix B contains map output from the NWS software SVRPLOT of tornado occurrences in the Tidewater region between 1950 and 2002.

4.1.5 Nor'easters

Nor'easters are coastal storms that develop off the mid-Atlantic Coast during late fall, winter and early spring. The storms are named after the direction of the prevailing winds. The storms may rapidly and unexpectedly intensify, gaining strength from the relatively warm air over the Atlantic Ocean. Simultaneously, colder air is forced southward along the East Coast. This mixture of warm and cold air can produce rain, snow, sleet, or freezing rain. The coastal plain of Virginia typically receives rain if the storm tracks over the coast or inland east of the Appalachian Mountains. When a storm center tracks east over the Atlantic Ocean, the Peninsula can receive record snowfalls.

Nor'easters generate strong northeast winds, heavy precipitation and storm surge on the Peninsula. Although the winds and storm surge associated with nor'easters are generally less intense than that of hurricanes, nor'easters can linger for several days over a given area. Storms with a long duration allow large accumulations of precipitation and damage to structures that are exposed to high wind and flooding. High-pressure systems to the north can hinder movement of the lows and serve to increase the severity of the low, thereby increasing the impacts of the storm.

The Dolan-Davis Scale (1993), Table 4.1.5a, was developed to identify and classify the damages that may occur during nor'easters. Although rarely referenced by the National Weather Service or other media in describing nor'easters (Sammler, 2005), the scale provides a useful descriptive tool for the types and levels of damage associated with a nor'easter. Heavy precipitation in the form of rain or snow, beach and dune erosion from wave action, sand/water overwash associated with storm surge, and resultant coastal property damage are all commonly associated with strong nor'easters.

Table 4.1.5a - Dolan-Davis Nor'easter Intensity Scale

Storm Class	Beach Erosion	Dune Erosion	Overwash	Property Damage
1 (Weak)	Minor changes	None	No	No
2 (Moderate)	Modest; mostly to lower beach	Minor	No	Modest
3 (Significant)	Erosion extends across beach	Can be significant	No	Loss of many structures at local level
4 (Severe)	Severe beach erosion and recession	Severe dune erosion or destruction	On low beaches	Loss of structures at community-scale
5 (Extreme)	Extreme beach erosion	Dunes destroyed over extensive areas	Massive in sheets and channels	Extensive at regional-scale; millions of dollars

Source: Davis and Dolan, 1993

Erosion

The exposed coastline of the Peninsula is subject to severe erosion during nor'easters and winter storms. Mechanical, chemical, and biological agents contribute to the wearing away or removal of coastal lands, resulting in a landward retreat of the shore. High waves and strong currents initiate coastal erosion, while breaking waves contribute to the process by suspending sediment particles and dislodging rocks. When the forces causing erosion occur at high tide, and especially during spring high tide, the resultant flooding and overwash can significantly increase the land loss and property damage. (Morton, 2003) The erosion of unconsolidated sediments and tidal wetlands throughout the Peninsula is a recurring hazard; however, private property losses and shoreline erosion are rarely quantified. The Virginia Institute of Marine Science continues to research the hazard, and maintains much data for the Gloucester Point area north of the Peninsula.

Tropical systems, nor'easters, and winter storms generate breaking waves and strong currents that have the effect of contributing new sediment to the littoral system and redistribute pre-existing sediments over large areas of the shoreface. A variety of factors, including beach composition and storm characteristics, determine how beaches are affected by storms. For example, retreat of bluffs and muddy shores occurs in an episodic, stepwise pattern without any seaward advancement between retreat events, as has historically occurred along the York River near Yorktown. Sandy beaches, like Buckroe Beach and Grandview in Hampton, tend to partially recover after storms. (Morton, 2003)

Historical Nor'easters

Almost every year, in late fall, winter or spring, the Peninsula is impacted by one or more nor'easters of varying degrees of severity. Table 4.1.5b provides a listing of historic nor'easters that have inflicted damage along the Virginia coastline, including the Peninsula. Due to the high frequency of these storms, communities on the Peninsula do not maintain detailed cost accounting for individual storms and the associated damage.

Table 4.1.5b - Historic Virginia Nor'easters

Date	Description
January 18-19, 1857	More than a foot of snow fell with temperatures in the single digits and teens across the state. Strong winds caused structural damage on land and wrecked ships at sea. One account states that Norfolk was buried under 20 foot drifts of snow. Temperatures fell to between -10° to -17° in the city. According to eyewitness accounts, the cold was so extreme that all Virginia rivers were frozen over. The Chesapeake Bay was solid ice a mile and a half out from its coast. At Cape Henry, one could walk out 100 yards from the lighthouse on the frozen ocean.
March 1-2, 1872	Known as the "Great Storm of 1872." During the evening of March 1, winds increased from the northeast to gale force (over 40 mph) on the coast and snow began blowing and drifting. It was very cold and the snow accumulated several inches. The wind drove water up into the Tidewater area and up the rivers. Water rose rapidly flooding wharves and the lower part of Norfolk.
April 11, 1956	Tidewater experienced gale winds (40 mph +) and unusually high tides. At Norfolk, the strongest gust was 70 mph. The strong northeast winds blew for almost 30 hours and pushed up the tide which reached 4.6 feet above normal in Hampton Roads. Thousands of homes were flooded by the wind-driven high water and damages were high. Two ships were driven aground. Waterfront fires were fanned by the high winds and, the flooded streets made access for firefighters very difficult, adding to the damages.
March 6,1962 Ash Wednesday Storm	The storm hit Virginia during spring tide, when sun and moon phase to produce a higher than normal tide. Storm moved north off the coast past Virginia Beach and then reversed its course moving again to the south and bringing with it higher tides and higher waves which battered the coast for several days. The storm's center was 500 miles off the Virginia Capes when water reached nine feet at Norfolk and seven feet on the coast. Huge waves toppled houses into the ocean and broke through Virginia Beach's concrete boardwalk and seawall. Houses on the Bay side also saw extensive tidal flooding and wave damage. An estimated $4 million in wind and flood damages occurred in Hampton. Winds up to 70 mph built 40-foot waves at sea. Flooding had a devastating effect on the Peninsula, including Grandview (Hampton) and Poquoson. Legendary storm caused over $200M (1962 dollars) damage from North Carolina to Long Island, New York.
January 27, 1998	Slow-moving nor'easter combined with high tides resulted in an extended period of gale force onshore winds, driving tides to 6.44 feet above MLLW at Sewells Point. Moderate coastal flooding was reported across the middle Peninsula and Northern Neck areas. The damage was estimated at $1.5 million.

Date	Description
March 13-14, 1993	The "Superstorm of March '93" was also known as "The Storm of the Century" for the eastern United States, due to its large area of impact, all the way from Florida and Alabama through New England. As the storm's center crossed Virginia, weather stations recorded their lowest pressure ever. Unlike most big winter storms that move up the coast, this storm took a more inland track across Richmond and the Chesapeake Bay. It brought rain and some high winds to Southeast Virginia and heavy snow and blizzard conditions over portions of the north and west. Eleven people died in Virginia from over-exertion and heart attacks shoveling snow or from exposure and hypothermia. Snow removal and clean-up costs were estimated at 16 million dollars statewide.
February 4,1998	Storm battered eastern Virginia for 3 days. Storm's slow movement resulted in an extended period of gale and storm force onshore winds, driving tides to 7.0 feet above MLLW at Sewell's Point in Norfolk. High tides resulted in severe coastal flooding throughout Hampton Roads and Eastern Shore. Damage was estimated at $75 million for Hampton Roads. $314,000 in costs incurred by York County government; approximately $75% direct damage, %20 debris-related, and 5% emergency response costs.
January 24-25, 2000	Storm spread heavy snow into Virginia. Several inches of snow was on the ground at daybreak on the 25th, with winds gusting at 25 to 45 mph, creating blizzard conditions in some areas. The region was at a standstill; airports and transit systems were shut down, schools were closed, Federal, state and county government offices were closed. Drifts of four to five feet were common. Snow mixed with sleet and freezing rain in some of the eastern counties of Virginia.

Source: VDEM 2004

4.1.6 Thunderstorms

Virginia averages 40 to 50 thunderstorm days per year (Sammler, 2005). Thunderstorms can occur any day of the year and at any time of the day, but are most common in the late afternoon and evening during the summer months, and in conjunction with frontal boundaries. Thunderstorms are generally beneficial because they provide needed rain for crops, plants, and reservoirs. About five percent of thunderstorms become severe and can produce tornados, large hail, damaging downburst winds, and heavy rains causing flash flooding. Thunderstorms can develop in less than 30 minutes, allowing little time for warning. The National Weather Service does not issue warnings for ordinary thunderstorms nor for lightning. The National Weather Service highlights the potential for thunderstorms in the daily forecasts and statements. Thunderstorms often create hazardous boating conditions for Peninsula mariners, who must be diligent in monitoring weather broadcasts for advance notice of late afternoon squalls or squall lines.

All thunderstorms produce lightning, which can be deadly. A bolt of lightning can strike 10 to 15 miles from the rain portion of a thunderstorm. The lightning bolt originates from the upper part of the thunderstorm cloud known as the anvil. A thunderstorm can grow up to 8 miles into the atmosphere where the strong winds aloft spread the top of the thunderstorm cloud out into an anvil. The anvil can spread many miles from the rain portion of the storm but it is still a part of that storm. Lightning bolts may come from the front, side or back of the storm, even striking after the rain and storm seem to have passed, or striking areas missed by rain.

Between 1959 and 2000, lightning killed 58 people in Virginia and injured at least 238 (Watson 2004). On the Peninsula, there have been at least 13 noteworthy lightning strikes since 1993, as shown in Table 4.1.6. The majority of the damage caused by lightning in the area was related to home strikes, and power line failures, but one person was reported injured and one person was reported killed. A typical 100-million volt lightning flash can heat the air to more than 40,000 degrees in an instant. This amazing amount of power can damage homes, down trees and power lines, and take lives. The best defense against this natural hazard is to recognize the danger and take shelter when appropriate.

Table 4.1.6- Recent Lightning Damage for Peninsula Communities*

Location	Date	Type	Death	Injury	Property Damage
Hampton	07/16/2003	Lightning	0	0	5K
Newport News	06/20/1996	Lightning	0	0	0
Newport News	06/19/2000	Lightning	0	0	100K
Newport News	06/06/2001	Lightning	0	0	0
Williamsburg	01/02/1996	Lightning	0	0	20K
Williamsburg	07/17/1995	Lightning	0	0	25K
Williamsburg	04/01/1993	Lightning	0	0	50K
Norfolk	09/04/1993	Lightning	0	1	500K
York County	06/26/2001	Lightning	0	0	0
Grafton	07/15/2000	Lightning	0	1	20K
Centerville	08/24/2000	Lightning	0	0	100K
Jamestown	08/30/2003	Lightning	1	0	0
James City County**	09/20/2005	Lightning	0	0	Roof damaged by fire, holes in roofs/walls

* Events shown were collected by NCDC and likely represent only a fraction of total lightning strikes.
****Daily Press*, 9/22/05

Figure 4.1.6 is based upon lightning strike data for the year 1989. The detector network established by the Electric Power Research Institute (EPRI) identified strikes, and the Virginia State Climatology Office compiled the map. Lightning data from EPRI are only available for a fee, and lightning data collected by NWS and NCDC do not detect all lightning strikes or occurrences. The figure below is only a one-year sample of the lightning climatology for the state; however, it depicts a distinct east-west geographic pattern of lightning strikes in 1989, with the Peninsula experiencing four to five flashes per square kilometer overall.

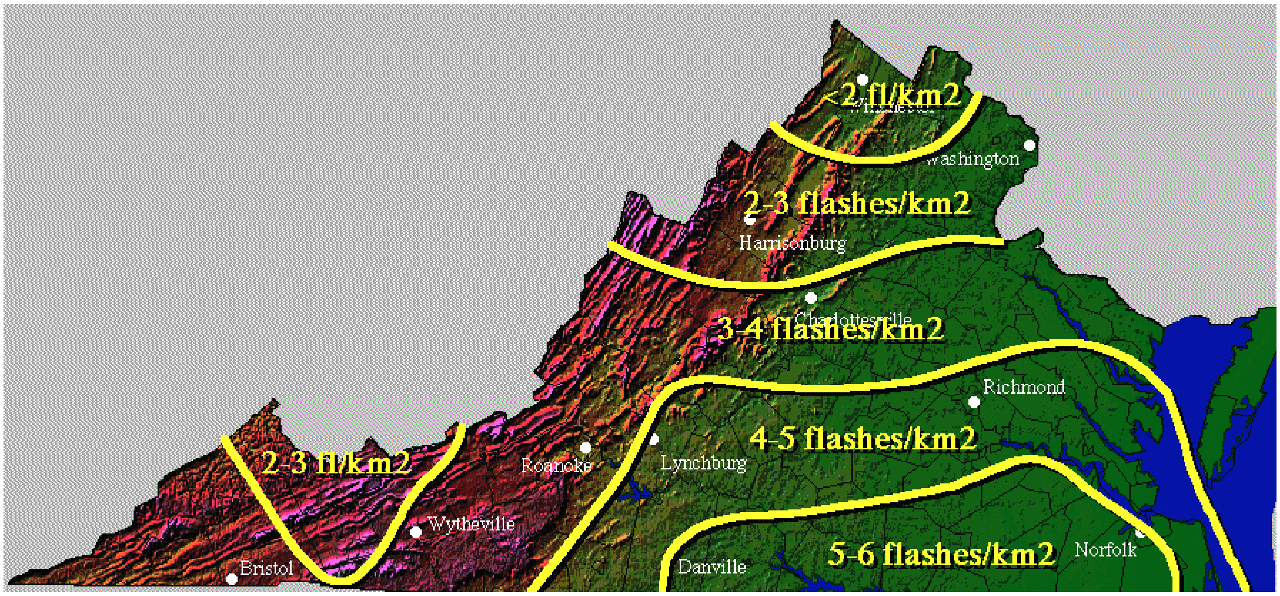
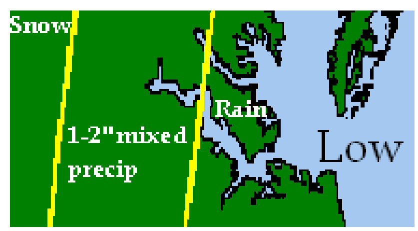


Figure 4.1.6 Virginia Lightning Strike Density Map for 1989 Only(State Climatology Office)

4.1.7 Winter Storms

Figure 4.1.7- Winter Storm Precipitation Pattern for the Peninsula



Source: VDEM 2004

Winter storms can refer to various types of precipitation including snow, freezing rain and ice. Sometimes winter storms are accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, severe drifting, and dangerous wind chill. Strong winds with these intense storms and cold fronts can knock down trees, utility poles, and power lines. Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the potentially extensive damage. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Heavy snow can immobilize a region and paralyze a community, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. The cost of snow removal, repairing damages, and loss of business can also have a significant economic impact on communities.

Although not all of Virginia's biggest winter storms are nor'easters, many of them are. At times, nor'easters have become so strong and produced such large amounts of blowing snow, that they have been termed "White Hurricanes."

Wind blowing counter clockwise around the storm center carries warm, moist air from the Gulf Stream up and over the cold inland air. The warm air rises and cools and snow begins. Heavy snow often falls in a narrow 50 mile wide swath about 150 miles northwest of the low pressure center (see Figure 4.1.7- Low pressure center or storm center is represented by "Low"). The Peninsula area is often affected by these storms.

It is also not uncommon for the Peninsula area to experience sleet, freezing rain, and ice storms. In fact, the Peninsula area has experienced 19 major winter weather events from 1993 – 2003. One such event occurred in December 1998. A major ice storm hit central and eastern Virginia, with ice accumulations of 0.5 – 1.0 inches that left dozens of power lines downed along with hundreds of tree limbs. Over 400,000 people in the area were left without power. The combination of automobile accidents, power line repair and clean-up cost the area over $20 million (NCDC 2004).

The recurrence of severe winter weather in the Peninsula area is certain. These winter storms often leave tree limbs and power lines down resulting in dangerous conditions. Other impacts can include collapsed roofs from fallen trees and heavy ice and snow loads as well as icy roads and sidewalks. Winter weather can have devastating effects on a community and occurs fairly frequently.

Table 4.1.7- Significant Winter Storm Events

Date	**Description**
January 18-19, 1857	See description in **Table 4.1.5b-Historic Virginia Nor'easters**
March 1-2, 1872	See description in **Table 4.1.5b-Historic Virginia Nor'easters**
November 17, 1873	Severe storm and gale brought high tides to tidewater area flooding wharves and the lower portion of Norfolk.
December 26-28, 1892	Norfolk set three local records for snow (Official Weather Records began in 1871). The greatest single storm amount with 18.6 inches; the most in 24 hours with 17.7 inches; and the maximum depth of snow on the ground with 18.6 inches. Normal snowfall at Norfolk is only 7.8 inches per year.
Winter of 1960-1961	Stormy pattern of previous winters continued with three more significant storms. The first was December 10-12, 1960 with heavy snow and high winds from Virginia to New York. In Virginia, snow fall ranged from 4 -13 inches in the north and west. Seven fatalities in Virginia. The next snowstorm struck on January 19-20 from North Carolina to New York. Virginia saw up to 12 inches. Two deaths were blamed on the storm in Virginia, due to overexertion and accidents. The third storm struck February 3-5 and hit like a blizzard with severe cold and gale force winds. Two to 13 inches of snow across Virginia, and four fatalities.
March 6, 1962 Ash Wednesday Storm	See description in **Table 4.1.5b-Historic Virginia Nor'easters**
Winter of 1980	On January 4 and 5, a heavy wet snow fell over eastern Virginia with as much as 18 inches reported at Williamsburg. A second storm hit on February 6 that dumped 6 inches in Williamsburg and as much as 20 inches at Virginia Beach. Over a foot of snow fell in Norfolk. Once again, arctic air had settled over Virginia and temperatures were in the teens. More than 1 foot of snow at Norfolk. The heavy snow combined with strong winds to create blizzard conditions. Norfolk's total for the season came to a

Date	Description
	record 41.9 inches making this the snowiest winter ever for eastern Virginia.
February 1989	This was a month of big swings in the weather for Southeast Virginia. Twice, Hampton Roads saw record high temperatures in the mid 70°s followed by a significant snowfall. The two storms that struck dumped a record 24.4 inches of snow at Norfolk. Over 14 inches occurred during one 24 hour period. It was the most snow to occur in one month in southeast Virginia in the last 100 years.
March 13-14, 1993	See description in **Table 4.1.5b-Historic Virginia Nor'easters**
January 6-8, 1996	Much of the eastern seaboard received 1 to 3 feet of snow. Wind gusts of over 50 mph were common and resulted in blizzard conditions for much of the east coast, including Virginia. Many areas of Virginia received over 20 inches of snow. Numerous accidents and flood related damages were reported in the area, along with 13 deaths in Virginia. Virginia, along with Ohio, Pennsylvania, Maryland, West Virginia and New York were declared Presidential Disaster Areas. All totaled the blizzard and resulting flooding killed and estimated 187 people and caused approximately $3 billion in damages along the eastern seaboard.
December 23, 1998	A prolonged period of freezing rain and some sleet resulted in ice accumulations of up to an inch. The heavy ice accumulations on trees and power lines caused widespread power outages. Many accidents occurred due to slippery road conditions, especially bridges and overpasses. Many secondary roads and parts of I-64 on the Peninsula were impassable due to fallen trees and tree limbs. Approximately 400,000 people were left without power in central and eastern Virginia and damages totaled more than $20 million. York County estimated at last $300,000 in damage costs incurred by the County; approximately 75% direct damage, 20% debris-related, and 5% emergency response costs.
February, 2004	On February 15 and 16, a winter storm hit the Tidewater area of Virginia dumping wind driven rain, freezing rain, and snow on a significant portion of Hampton Roads. Snow accumulation totals in some areas reached three to six inches and winds were reported at up to 30 mph. Sleet fell across much of the region causing roads to become icy and treacherous.

Source: NCDC

4.1.8 Extreme Heat

Extreme heat hazards result from high daily temperatures combined with high relative humidity. High relative humidity retards evaporation, robbing the body of its ability to cool itself. On average, about 175 Americans succumb to the taxing demands of heat every year (NOAA 2004).

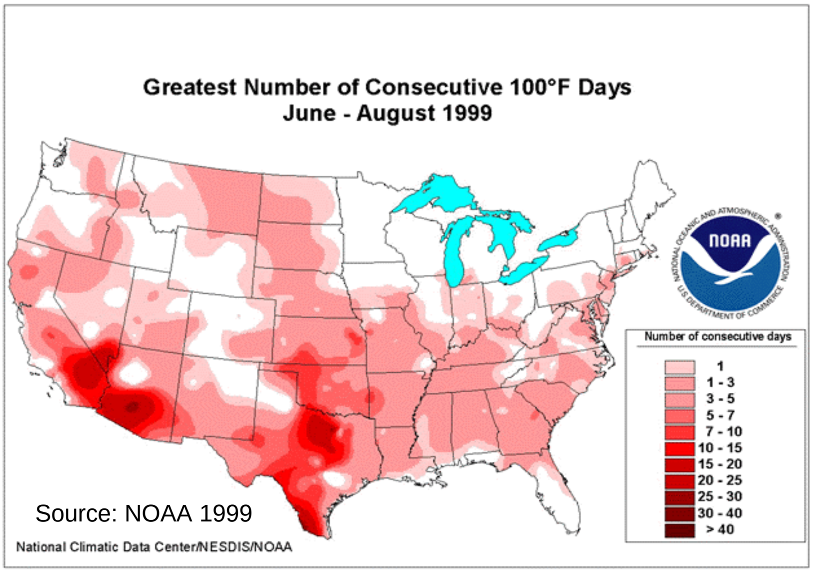
When heat gain exceeds the level the body can remove, body temperature begins to rise, and heat related illnesses and disorders may develop. The Heat Index (HI) is the temperature the body feels when heat and humidity are combined. Table 4.1.8 shows the HI that corresponds to the actual air temperature and relative humidity. This chart is based upon shady, light wind conditions. Exposure to direct sunlight can increase the HI by up to 15°F. (NOAA 2004).

Table 4.1.8 -Heat Index

Temperature (°F)	Relative Humidity					
	90%	80%	70%	60%	50%	40%
80	85	84	82	81	80	79
85	101	96	92	90	86	84
90	121	113	105	99	94	90
95		133	122	113	105	98
100			142	129	118	109
105				148	133	121
110						135

Source: NOAA 2004

Figure 4.1.8-Greatest Number of Consecutive 100°F Days



During the summer (June-August) of 1999, the United States experienced an intensifying drought and heat wave. The east coast was the area hardest hit by the drought, with record and near-record short-term precipitation deficits occurring on a local and regional scale resulting in agricultural losses and drought emergencies being declared in several states (NOAA 1999). Figure 4.1.8 shows the number of consecutive days of 100° temperatures.

The threat of extreme heat to the Peninsula communities is episodic and, although it cannot be controlled, threats to the population can be minimized by warnings and public awareness of the potential dangers that extreme heat presents.

4.1.9 Dam Failure

For the purposes of this plan, dam failure is addressed as a natural hazard resulting in a flooding condition. Dam failure can occur if hydrostatic pressure behind a dam exceeds design capacity or the crest of the dam is over-topped and rushing flood water scours the base of the dam. The hazard classification associated with dam failure is outlined below. Dams that meet regulatory criteria in Virginia are regulated under the Dam Safety Act established by the Virginia Soil and Water Conservation Board (VS&WCB). A dam may be exempt from the regulation if any of the following criteria apply:

- dam is less than 6 feet in height,
- dam has a capacity less than 50 acre-feet and is less than 25 feet in height,
- dam has a capacity of less than 15 acre-feet and is more than 25 feet in height,
- dam is used for primarily agricultural purposes and has a capacity less than 100 acre-feet (should use or ownership change, the dam may be subject to regulation),
- dam is owned or licensed by the Federal Government, or
- dam is operated for mining purposes under 45.1-222 or 45.1-225.1 of the *Code of Virginia*.

Dams are assigned a hazard classification based on the downstream loss anticipated in the event of dam failure. Hazard potential is not related to the structural integrity of the dam. The hazard potential classification speaks to the level of risk to life and economic loss the dam imposes on downstream properties and facilities. The classification scheme used by VS&WCB is as follows:

- **Class I** - dams which upon failure would cause probable loss of life or excessive economic loss,
- **Class II** - dams which upon failure could cause possible loss of life or appreciable economic loss,
- **Class III** - dams which upon failure would not likely lead to loss of life or significant economic loss, and
- **Class IV** - dams which upon failure would not likely lead to loss of life or economic loss.

The owner of each regulated Class I, II, or III dam is required to apply for an operational and maintenance certificate from VS&WCB. One of the requirements for obtaining the operational and maintenance certificate is the development of an emergency action plan. These plans are filed with the local emergency management official and VDEM. Table 4.1.9 provides the number of dams by classification for each community on the Peninsula. For further information regarding specific dams, please contact the local emergency management department.

Community	High Hazard		Low Hazard	
	Class I	Class II	Class III	Class IV
Hampton	0	0	0	0
Newport News	0	2	0	0
Williamsburg	0	1	1	1
James City County	0	0	1	0
York County	0	1	1	0

Table 4.1.9 - Number of Dams by Community and Hazard Classification

4.1.10 Wildfire

A wildfire is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures. Wildfires often start unnoticed and spread quickly, causing dense smoke that fills the area for miles around. Naturally occurring and non-native species of grasses, brush, and trees fuel wildfires. (FEMA, How-to Guide, 2-29) Generally, there are three major factors to consider in assessing the threat of wildfires to a community: topography, vegetation, and weather.

The type of land cover in an area affects a number of factors including ease of ignition, the intensity with which a fire burns, and the facilitation of wildfire advancement. Topographic variations, such as steep slopes, can lead to a greater chance of wildfire ignition. Generally, steep slopes are predisposed to convective pre-heating, which warms and dries the vegetative cover. Also, slopes that face south receive more direct sunlight than those facing north. Direct sunlight dries vegetative fuels, creating conditions that are more conducive to wildfire ignition. Population density has a causal relationship to wildfires because humans ignite an overwhelming majority of the wildfires in Virginia, intentionally or unintentionally. Travel corridors increase the probability of human presence, which increases the potential for wildfire ignition. Hence, areas close to roads have a higher ignition probability. Storms such as hurricanes and winter ice storms can topple trees, creating an enormous amount of debris, which can serve as wildfire fuel.

Recently, Hurricane Isabel brought down thousands of trees on the Peninsula. The resultant increase in potential fuel initiated a public awareness campaign by VDOF to educate the public regarding the increased hazard.

According to VDOF, approximately 30 percent of the Peninsula land area is a high fire risk zone, 38 percent is a moderate fire risk zone, and 32 percent is a low fire risk zone. See Appendix B for a map showing the boundaries of the wildfire hazard areas for all Peninsula communities. Table 4.1.10 summarizes the percentage of land area exposed to wildfire hazard for each Peninsula community. VDOF reports that there were approximately 32 wildfires on the Peninsula between 1995 and 2001, which resulted in approximately 70 acres of burned land (VDOF 2003).

Table 4.1.10 -Wildfire Hazard for Peninsula Communities

Community	Land Area (sq. mi.)	Fire Risk (sq. mi.)		
		High	Medium	Low
Hampton	51.8	3.5 (6.7%)	6.0 (11.6%)	42.3 (81.7%)
Newport News	176.9	16.1 (9.1%)	36.8 (20.8%)	124.0 (70.1%)
Williamsburg	8.5	0.8 (9.0%)	3.1 (36.1%)	4.7 (54.9%)
James City County	143.0	47.6 (33.3%)	18.0 (12.6%)	77.4 (54.1%)
York County	106.0	53.0 (50.0%)	42.3 (39.9%)	10.7 (10.1%)
Total	486.2	147.8 (30.4%)	183.8 (37.8%)	154.1 (31.7%)

4.1.11 Drought

All of the Peninsula communities are susceptible to droughts, which are defined by a combination of intensity and duration. In a one-year time frame, droughts are considered large when the 12-month rainfall averages about 60 percent of normal. On a multi-year time scale, 75 percent of normal rainfall indicates a serious problem. High summer temperatures can exacerbate the severity of a drought. Normal high summer temperatures in central and eastern Virginia can reach the 90 degree mark and higher. Most of the soil is relatively wet, and a great deal of the sun's energy goes toward evaporation of the ground moisture. However, when drought conditions eliminate soil moisture, the sun's energy goes toward heating the ground surface and temperatures reach into the low 100's – further drying the soil. This can have a devastating effect on crops, stream levels and water reserves. A short-term precipitation deficit of six summer weeks can often ruin crops. Droughts lasting a year, which occur in the Mid-Atlantic when the region receives 60 percent of the typical 40 inches of rain, begin to draw down water wells and livestock ponds and decrease stream flows and water reserves.

VDEM rates Virginia's drought risk as "Significant," with Virginia communities experiencing approximately 20 years of severe drought in the last century. These droughts have caused millions of dollars of damage. There are two primary drought monitoring tools currently in use in the United States. The Palmer Drought Index (PDI) has been used for U.S. drought monitoring for the last 30 years. It is based on a water budget model that incorporates the balance between water supply (i.e., precipitation), soil moisture, runoff, and water demand (computed from estimates for evaporation and transpiration). The U.S. Drought Monitor is a blend of science and subjectivity, resulting in a drought severity classification table based on ranges for primary indicators for each dryness level. Because the ranges of the various indicators often do not coincide, the final drought category tends to be based on what the majority of the indicators show. The analysts producing the map also weight the indices according to how well they perform in various parts of the country and at different times of the year. The PDI is one of many indicators used to develop the U.S. Drought Monitor. Other indicators include: soil moisture, weekly streamflow, standardized precipitation, and a satellite vegetation health index. Table 4.1.11 provides a description of possible impacts for the drought severity categories indicated by the U.S. Drought Monitor.

Table 4.1.11 -U.S. Drought Monitor, Drought Severity Classification

Category	Description	Possible Impacts
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.
D1	Moderate Drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested
D2	Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed
D3	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells, creating water emergencies

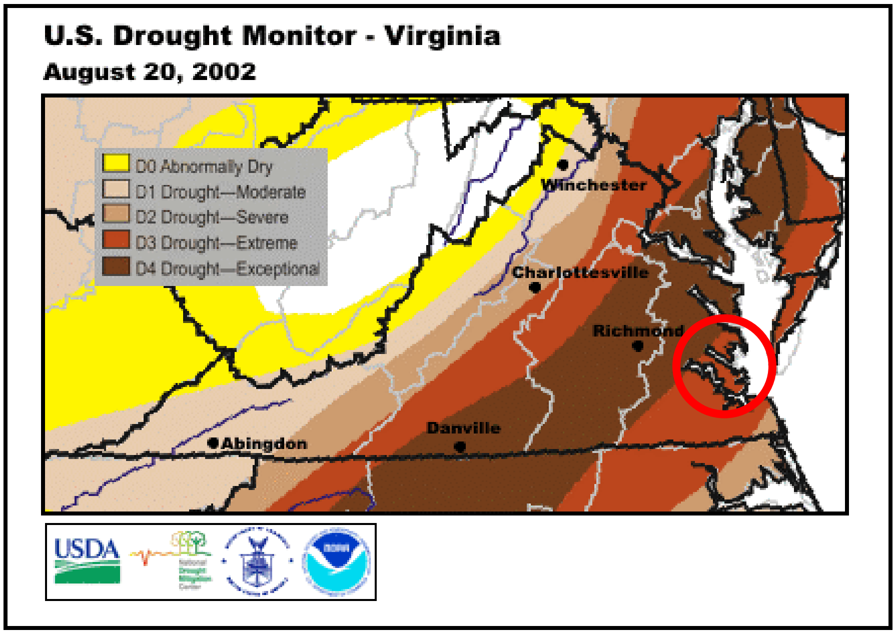
Since the early 1900s, there have been six major droughts that have affected the communities on the Peninsula. The drought of 1930-32 was one of the most severe droughts recorded in the region. The droughts of 1938-42 and 1962-71 were less severe; however, the 1962-71 drought had an extreme duration. The droughts of 1980-82 and 1998-99 were the least severe for the state; however, the drought of 1998-99 hit the communities of the Peninsula region particularly hard. The drought of 2000-2002 was felt statewide, and is considered the most significant since the 1930-32 event. (Sammler, 2005)

The drought of 1930-32 had a tremendous effect on Virginia. Numerous rivers completely dried up, crops were totally destroyed, drinking water was difficult to find, forest fires burned approximately 300,000 acres of land (over 30 times the current annual average) and average summer temperatures were in the low 100's. After adjusting for inflation, the estimated losses for this drought were $1 billion. If the same drought were to occur in Virginia today, the devastation would be much greater due to an increased population and demand for water resources.

The drought of 1998-99 had a particularly hard impact on the Peninsula. The region received some of the lowest rainfall totals in over 120 years. This led to decimated crops and depletion of water and feed reserves, as well as a number of brush fires. Many stream-gauging stations reported streamflow at or below 10 percent of the normal flow. On December 1, 1998, the

Governor declared a state of emergency and requested federal aid. Losses in the region grew to nearly $190 million. During August of 1999, NOAA ranked the Peninsula area in a moderate to severe drought.

Figure 4.1.11- U.S. Drought Monitor, August 20, 2002



Following shortly on the heels of the 1998-99 drought, the designated drought of 2000-2002 reached its height in late summer, early fall of 2002. The Virginia Drought Monitoring Task Force, a consortium of interested state and Federal agencies, provided Drought Status Reports on a monthly basis between June and November 2002. Conditions deteriorated quickly in the first two weeks of August 2002, and the U.S. Drought Monitor indicated an "Extreme Drought" for the Peninsula (see Figure 4.1.11) by August 20th. Drought indicators were numerous and severe: record minimum flows on the James and York Rivers, continually declining groundwater levels, declining reservoir levels, short or very short topsoil moisture conditions across 82 percent of the Commonwealth, numerous ozone advisories, and higher than normal wildfire activity. For the Tidewater area, normal one-year precipitation for the period September 2001 to August 2002 was 41.17 inches. By August 20, 2002, the one-year precipitation was only 29.35 inches, a 71-percent departure from normal. Newport News Waterworks customers were under voluntary conservation measures beginning July 25, with the reservoir at 71 percent capacity. James City Service Authority Central System instituted voluntary measures, as well. The Waller Mill Reservoir serving Williamsburg dropped 27 inches below the spillway, and voluntary conservation measures went into effect on March 20, 2002. Williamsburg was purchasing water from Newport News Waterworks in July. By November 2002, much of the Peninsula area had returned to normal conditions due to rainfall after September 1st.

4.1.12 Earthquakes

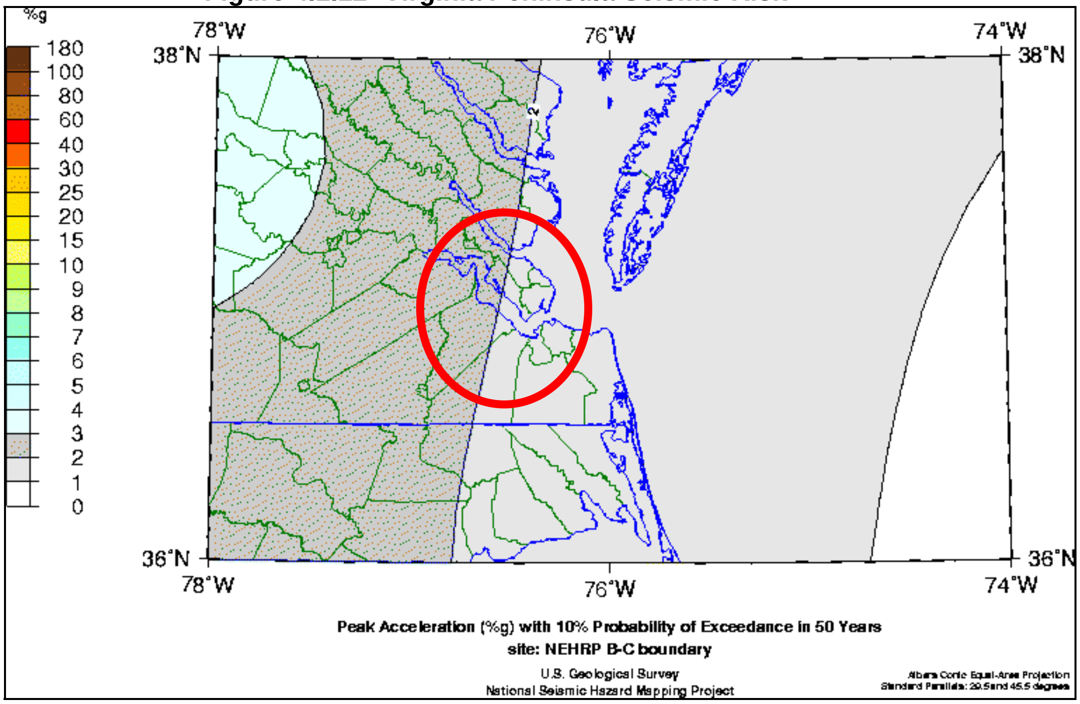
The earth's outer surface is broken into pieces called tectonic plates, which move away from, towards or past each other. Because the continents are part of these plates, they also move. An earthquake occurs when the stresses caused by plate movements are released. The abrupt release of stored energy in the rocks beneath the earth's surface results in a sudden motion or trembling of the earth. The epicenter is the point on the Earth's surface directly above the source of the earthquake.

Smaller earthquakes occur much more frequently than large earthquakes. These smaller earthquakes generally cause little or no damage. However, very large earthquakes can cause tremendous damage and are often followed by a series of smaller aftershocks lasting for weeks after the event. This phenomenon, referred to as 'minor faulting,' occurs during an adjustment period that may last for several months.

Virginia and the eastern side of the North American continent are in the middle of a tectonic plate. The states east of the Mississippi River have fewer earthquakes than the western portion of the country. Quakes occurring in the west are typically stronger, but eastern earthquakes can cause more damage away from their origin because the underlying bedrock is well-connected (like a concrete slab). This geology allows eastern earthquakes to travel farther than in the west, where the underlying topography is so disconnected (like a brick patio) that the energy of a quake is dissipated closer to the epicenter.

According to the Virginia Department of Mines, Minerals and Energy, Virginia has a moderate earthquake risk (similar to most states on the eastern seaboard). This risk assessment is further supported by the USGS. The USGS rates areas of the United States for their susceptibility to earthquakes based on a two or ten percent probability of a given peak force, being exceeded in a 50 year period. Based on the map shown in Figure 4.1.12, the Virginia Peninsula lies in an area of moderate seismic risk, with a 10% chance in the next 50 years that a peak acceleration of one to three percent g will be equaled or exceeded.

Figure 4.1.12- Virginia Peninsula Seismic Risk



The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The magnitude of an earthquake is determined from the logarithm of the amplitude of waves recorded by seismographs. Adjustments are included for the variation in the distance between the various seismographs and the epicenter of the earthquakes. On the Richter Scale, magnitude is expressed in whole numbers and decimal fractions. For example, a magnitude 5.3 might be computed for a moderate earthquake, and a strong earthquake might be rated as magnitude 6.3. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude; as an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

The effect of an earthquake on the Earth's surface is called the intensity. The intensity scale consists of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys, and finally, total destruction. Although numerous *intensity scales* have been developed over the last several hundred years to evaluate the effects of earthquakes, the one currently used in the United States is the Modified Mercalli Intensity (MM) Scale. It was developed in 1931 by the American seismologists Harry Wood and Frank Neumann. This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It does not have a mathematical basis; instead it is an arbitrary ranking based on observed effects.
The Modified Mercalli Intensity value assigned to a specific site after an earthquake has a more meaningful measure of severity to the nonscientist than the magnitude because intensity refers to the effects actually experienced at a particular place.

The lower numbers of the intensity scale deal with the manner in which people feel the earthquake. The higher numbers of the scale are based on observed structural damage. Structural engineers usually contribute information for assigning intensity values of VIII or above. The following is an abbreviated description of the 12 levels of Modified Mercalli intensity:

Table 4.1.12a- Modified Mercalli Intensity Scale

Level	Description
I	Not felt except by a very few under especially favorable conditions.
II	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Historically significant Virginia earthquakes were first recorded in 1774. Virginia has had over 160 earthquakes since 1977, of which 16 percent were felt. This equates to an average of one earthquake occurring every month with two felt each year (VTSO, 2005). On February 21, 1774, a strong earthquake was felt over much of Virginia and southward into North Carolina. Many houses were moved considerably off their foundations at Petersburg and Blandford (intensity MM VII). The shock was described as "severe" at Richmond and "small" at Fredericksburg. However, it "terrified the inhabitants greatly." The total felt area covered about 57,900 square miles.

The three great earthquakes near New Madrid, Missouri, in 1811 - 1812 (December 11th, January 23rd, and February 7th) were felt strongly in Virginia. Reports from Norfolk and Richmond newspapers describe the effects in detail.

An earthquake, apparently centered in southwestern Virginia, on March 9, 1828, was reported felt over an area of about 218,090 square miles, from Pennsylvania to South Carolina and the Atlantic Coastal Plain to Ohio. Very few accounts of the shock were available from places in Virginia; it was reported that doors and windows rattled (MM V). President John Quincy Adams felt this tremor in Washington D.C., and provided a graphic account in his diary. He compared the sensation to the heaving of a ship at sea.

The August 27, 1833, earthquake covered a broad felt area from Norfolk to Lexington and from Baltimore, Maryland, to Raleigh, North Carolina - about 52,110 square miles. Two miners were killed in the panic the shock caused at Brown's Coal Pits, near Dover Mills, about 18 miles from Richmond. At Charlottesville, Fredericksburg, Lynchburg, and Norfold, windows rattled violently, loose objects shook, and walls of buildings were visibly agitated (MM V).

Another moderately strong widely felt shock occurred on April 29, 1852. At Buckingham and Wytheville, chimneys were damaged (MM VI). The felt area extended to Washington D.C., Baltimore, Maryland, and Philadelphia, Pennsylvania, and also included many points in North Carolina - approximately 162,120 square miles. This pattern was repeated on August 31, 1861. The epicenter was probably in extreme southwestern Virginia or western North Carolina. At Wilkesboro, North Carolina, bricks were shaken from chimneys (MM VI). The lack of Virginia reports may perhaps be ascribed to the fact that the Civil War was under way and there was heavy fighting in Virginia at the time. This shock affected about 299,150 square miles and was felt along the Atlantic coast from Washington, D.C., to Charleston, South Carolina, and westward to Cincinnati, Louisville, and Gallatin, Tennessee, and southwestward to Columbus, Georgia.

A series of shocks in quick succession disturbed the eastern two-thirds of Virginia and a portion of North Carolina on December 22, 1875. At Manakin, many chimneys were broken and shingles on one store were shaken off (MM VII). Damage to chimneys was reported from other places in Goochland and Powhatan Counties. At Richmond, the shock, which was accompanied by a rumbling noise, was severe and lasted from 20 to 30 seconds; plaster fell and several panes of window glass broke. There was general alarm in all parts of the city; many people ran out of their houses in fright. The total felt area was about 50,180 square miles.

The famous 1886 earthquake in Charleston, South Carolina was felt on the Virginia Peninsula, and the Hampton Roads region. Plaster damage in Williamsburg, as well as broken chimneys in nearby Norfolk were typical of impacts throughout the Commonwealth. In Norfolk, light framework was thrown down, large warehouses were damaged, and the earthquake caused panic in the Opera House. The event led to reports of nausea among many residents of Norfolk, and had an estimated magnitude of 6.6 to 6.9, and was felt as far north as Canada and as far south as Cuba. Residents of Missouri also felt the earthquake.

The largest earthquake to originate in Virginia is historic times occurred on May 31, 1897. The epicenter was in Giles County, where on May 3rd, an earlier tremor at Pulaski, Radford, and Roanoke had caused damage (MM VI). Loud rumblings were heard in the epicentral region at various times between May 3rd and 31st. The shock on the latter date was felt from Georgia to Pennsylvania and from the Atlantic Coast westward to Indiana and Kentucky, an area covering about 279,850 square miles. It was especially strong at Pearisburg, where the walls of old brick houses were cracked and bricks were thrown from chimney tops. Springs were muddied and a few earth fissures appeared (MM VIII). Chimneys were shaken down at Bedford City, Houston, Pulaski, Radford, and Roanoke. Chimneys were also broken at Raleigh, North Carolina, Bristol and Knoxville, Tennessee, and Bluefied, West Virginia. Minor tremors continued in the epicentral region from time to time until June 6th; other disturbances felt on June 28th, September 3rd, and October 21st were probably aftershocks. On February 5, 1898, the residents of Pulaski reported additional chimney damage (MM VI). In Newport News, there were reports that the earthquake "frightened a great many people." The shake was more perceptible "near the edge of the water, where it caused the piers and buildings to rock," but no damage was reported. In Williamsburg, the earthquake was felt by "nearly everybody in town.". (VTSO 2005)

An earthquake on February 11, 1907, caused minor damage at Arvonia, Ashby, and Buckingham. At Arvonia, many people became terrified and ran from their houses (MM VI); although no damage was reported from Columbia, many ran from their homes. The felt area was small, approximately 5600 square miles. Other shocks of lesser intensity occurred in the same area on August 23, 1908, and May 8, 1910.

The Shenandoah Valley region was strongly shaken by an earthquake on April 9, 1918. It was called the "most severe earthquake ever experienced" at Luray. Although little damage resulted, people in many places over the northern valley region were greatly alarmed and rushed from their houses (MM VI). Broken windows were reported at Washington, D.C. President Wilson and his family at the White House noticed the tremor; the President's secretary called a newspaper office to learn the cause of the terrifying noise. The felt area extended over 60,000 square miles, including parts of Maryland, Pennsylvania, and West Virginia. Another shock on September 5, 1919, was felt in the same general region, although the total affected area was much smaller. It was strongest in the Blue Ridge Mountains south of Front Royal. At Arco, plaster fell and some chimneys were damaged (MM VI). Springs and streams were muddied in the epicentral area.

On December 26, 1929, a moderate shock at Charlottesville shook bricks from a few chimneys (MM VI). It was reported felt in various parts of Albemarle County. A number of newspaper accounts gave the date of this earthquake as December 25th. Giles County was strongly shaken again on April 23, 1959. At Eggleston and Pembroke, several chimneys were damaged, plaster cracked, and pictures fell from walls (MM VI). A wide area (about 2,900 square miles) of southwestern Virginia felt the tremor; a few places in West Virginia also reported the shock. (USGS 2005)

The April 23, 1959 earthquake was strongest in Giles County, at Eggleston and Pembroke. Residents there reported several damaged chimneys and articles shaken from shelves and walls. One chimney toppled at the Norfolk and Western Station in Eggleston. The quake was also felt in West Virginia.

An earthquake in southwest Virginia on November 11, 1975 broke windows in the Blacksburg area of Montgomery County, and plaster cracked at Poplar Hill. The quake was also felt in Pulaski County. Another southwest Virginia event on September 13, 1976 was observed in many towns in North Carolina and Virginia and in a few towns in South Carolina and West Virginia. Bricks fell from chimneys and pictures fell from walls in Surry County at Mount Airy, N.C. At the nearby town of Toast, N.C., cracks formed in masonry and plaster. (VTSO 2005)

The *Daily Press* and *Virginian-Pilot* newspapers reported a minor, but relatively rare, earthquake with its epicenter on the Peninsula August 3, 1995. According to the *Virginian-Pilot*, the quake measured 2.6 on the Richter scale. The Virginia Tech Seismological Observatory detected the quake with instrumentation in Goochland County west of Richmond, and in Blacksburg. The quake was centered under the York River near York River State Park. According to the *Daily Press*, people at Camp Peary reported feeling the quake.

The December 9, 2003 Powhatan County earthquake was a complex event consisting of two sub-events occurring 12 seconds apart. Slight damage (MM VI) was reported at Bremo Bluff and Kents Store. The event was felt (MM V) at Columbia, Fork Union, Goochland, Oilville, Rockville and Sandy Hook; (MM IV) at Appomattox, Amelia Court House, Amherst, Blackstone, Bumpass, Charlottesville, Chester, Chesterfield, Colonial Heights, Cumberland, Dillwyn, Farmville, Glen Allen, Lawrenceville, Louisa, Manakin Sabot, Mechanicsville, Midlothian, Mineral, Palmyra, Petersburg, Powhatan, Richmond, Scottsville and Spotsylvania; (MM III) at Alexandria, Fairfax, Falls Church, Fredericksburg, Lexington, Lynchburg, McLean, Roanoke, Staunton and Vienna. It was also felt (MM III) at Bethesda, Rockville and Silver Spring, Maryland and at Rocky Mount and Winston Salem, North Carolina. Felt (MM II) at Chapel Hill, Greensboro and Raleigh, North Carolina and at Washington, DC. Felt in much of Maryland and Virginia and in north-central North Carolina and a few areas of Delaware, New Jersey, New York, Pennsylvania and West Virginia.

A summary of collected data for historical, significant and recent earthquakes in the region is provided in Table 4.1.12. Because the data was gathered from a variety of sources, all indicators are not available for each event.

Table 4.1.12b -Summary of Virginia Earthquake Data

Year	Location	Focus Depth (km)	Deaths	Damage ($)	Richter Scale Magnitude	MMI	Felt Area (square miles)
1774	Near Petersburg	not available	0	0	4.5	6	58,000
1828	Location not recorded	not available	0	0	4.6	5	
1833	Central Virginia	not available	0	0	4.5	5	52,000
1852	Near Wytheville	not available	0	0	4.8	6	174,500
1852	Central Virginia	not available	0	0	4.3	6	32,000
1853	Location not recorded	not available	0	0	4.6	5	
1875	Central Virginia	not available	0	0	4.8	7	50,000
1885	Nelson County	not available				6	25,000
1897	Giles County	not available	0	0	5.6	8	280,000
1897	Southwest Virginia	not available	0	0	4.3	6	89,500
1898	Pulaski	not available	0	0	4.4	6	34,000
1898	Location not recorded	not available	0	0	4.5	5	
1899	Location not recorded	not available	0	0	4.5	5	
1907	Near Arvonia	not available	0	0	4	6	5,600
1918	Luray	not available	0	0	4.6	6	65,000
1919	Near Front Royal	not available	0	0	0	6	
1929	Charlottesville	not available	0	0	3.7	6	1,000
1954	Lee County	not available				6	
1959	Giles County	1	0	0	3.9	6	2,050
1969	Rich Creek					6	100,000
1975	Southwest Virginia	1	0	0	3.2	6	
1976	Southwest Virginia	9	0	0	3.3	6	9,000
1991	Virginia	18	0	0	0	5	
1995	York River	not available	0	0	2.6	not available	
1997	Near Culpeper	not available	0	0	2.5	not available	
1997	Near Manassas	not available	0	0	2.5	not available	
1997	Near Galax	not available	0	0	2.2	not available	
1998	Near Dillwyn	not available	0	0	3.8	not available	
2001	Shadwell, east of Charlottesville	not available	0	0	3.2	not available	
2003	30 miles SE of Charlottesville	not available	0	0	3.9	not available	
2003	Near Ashland	not available	0	0	2.6	not available	
2003	Powhatan County	< 5	0	0	4.5	6	~22,500

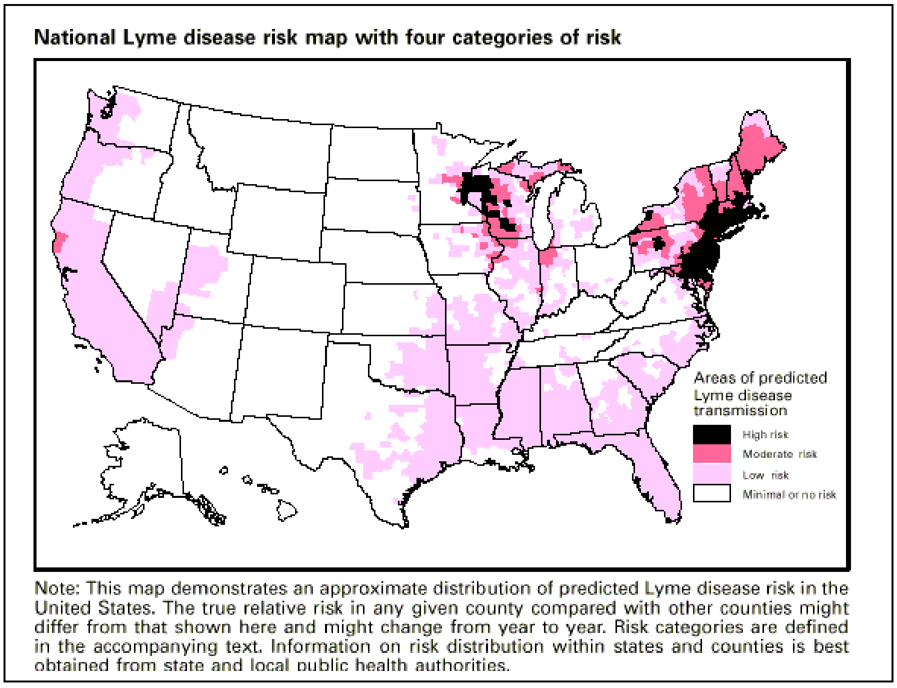
Sources: USGS, National Atlas, 30 June 1999
Daily Press and *Virginian-Pilot*, August 4, 1995
USGS Significant Earthquakes of the World for 2003 web site
Washington Post, December 10, 2003

4.1.13 Biological Hazards/Epidemics

Biological hazards originate from naturally occurring substances such as bacteria, fungi, molds and viruses. In many cases these hazards are not visible, yet they can cause serious health effects to humans, plants and animals. West Nile Virus, Lyme disease, and bacterial epidemics have all been documented in the Peninsula region within the last ten years.

West Nile Virus (WNV) was first reported in the United States in 1999. Since then, almost 10,000 people have fallen ill across the country. WNV is transmitted to humans through mosquito bites and usually causes little reaction. However, a small percentage of those infected develop mild symptoms that include fever, headache, body aches, skin rash, and swollen lymph glands. Less than one percent of infected people develop a more severe illness that can include meningitis (inflammation of one of the membranes covering the brain and spinal cord) or encephalitis. The Peninsula communities have taken a proactive stance against WNV by attempting to eliminate mosquito populations and breeding grounds, especially those created by trees felled during Hurricane Isabel. Some of the techniques used are low volume spraying, draining areas of standing water, and introducing mosquito-eating fish. Additionally, York County coordinates with the Virginia Department of Transportation (VDOT) to maintain easements and right-of-ways that contain standing water. According to the Virginia Department of Health, there were 101 positive WNV cases for animals (birds, horses, and mammals) in the Peninsula region from 2000 to 2003. There was one probable case of human WNV in the City of Newport News in 2003.

Figure 4.1.13 -National Lyme Disease Risk Map



Source: CDC 2004

Lyme disease is a bacterial infection that can afflict humans and animals. It is most commonly transmitted to humans bitten by deer ticks. If Lyme disease goes untreated, some patients may develop arthritis, including intermittent episodes of swelling and pain in the large joints; neurological abnormalities, such as meningitis, facial palsy, motor and sensory nerve inflammation and encephalitis; and cardiac problems, such as an enlarged heart and inflammation of the heart tissue. The Peninsula region is an area of low risk for Lyme disease transmission, according to the Centers for Disease Control and Prevention (CDC 2004); see Figure 4.1.13. In 2002, the CDC reported 259 cases of Lyme disease (out of 23,763 nationwide) in Virginia.

Bacteria and viruses can cause water contamination and have disastrous effects on the animals living within polluted waterways. In some instances, pollution from storm flooding and combined sewer overflow may produce high levels of fecal coliform bacteria and viruses in rivers and drinking water. The Poquoson River, Chisman Creek, Patrick's Creek, Lambs Creek, Roberts Creek, and Lyons Creek are all listed as bacteria impaired water body segments on the VDEQ's 2003-2004 Total Maximum Daily Load schedule.

4.1.14 Landslide

Landslides constitute a major geologic hazard because they are widespread, occurring in all 50 states. Landslides cause $2 billion in damage annually and more than 25 fatalities on average each year (USGS 2003). Landslides can and do occur in conjunction with other natural hazards, such as heavy rain events and earthquakes or human activities like excavations. Landslides can be broken down into falls, flows, or slides based on the type of earth movement (USGS 2003).

Most of the Peninsula area is classified as low landslide risk on the Landslide Incidence and Susceptibility Map (USGS 2001). There are however small areas that are listed as Moderate. These areas occur in Hampton, James City County, Newport News, and York County (see Appendix B for Landslide Hazard Map). The data used to generate these maps (USGS 2001) was highly generalized; therefore, further investigation at the local level is recommended.

4.1.15 Expansive Soils

Soils with a sufficient content of certain types of clay experience a change in volume during a transition from dry to wet conditions. These soils are called expansive soils, or "shrink-swell" soils. Hazards associated with expansive soils arise from the change in volume experienced. This physical factor can result in slope instability and cause damage to building foundations. Each community within the Peninsula region addresses the issue of expansive clay in their respective comprehensive plans, and addresses soil conservation based on state standards set forth in the Virginia Erosion and Sediment Control Law and Regulations.

4.1.16 Tsunami

"Tsunami" is a Japanese word meaning "harbor wave" and is a water wave or a series of waves generated by an impulsive vertical displacement of the surface of the ocean or other body of water (NOAA 2005b). A tsunami can occur when a series of ocean waves are generated by a sudden displacement in the sea floor, landslides, or volcanic activity. In the ocean, the tsunami wave may only be a few inches high. The wave may come gently ashore or may increase in height to become a fast moving wall of turbulent water several meters high (NOAA 2005a).

Tsunamis, commonly called seismic sea waves-or incorrectly, tidal waves, have been responsible for at least 470 fatalities and several hundred million dollars in property damage in the United States and its territories. These events are somewhat rare and major tsunamis occur in the Pacific Ocean region only about once per decade (NOAA 2005b).

Tsunamis have occurred only rarely along the Atlantic Coast. The National Geophysical Data Center (NGDC) administered by NOAA maintains a database of worldwide tsunami events recorded since 2000 B.C. According to the NGDC database, there have been 39 events along the North American Atlantic coast that have generated tsunamis.

According to the most recent data, in order for a tsunami to impact the East Coast, an earthquake with a magnitude of 9.0 or greater would need to take place north of Puerto Rico. Although the chances of a tsunami impacting the coast are minute, it could potentially produce waves from four to six feet along the coast. (Sammler, 2005) Klaus Jacob of the Lamont-Doherty Earth Observatory in New York estimated that a tsunami "has a lower than 1 in 1000 chance of occurring in eastern North America in any given year" (Boston Globe, 2004).

Because of the irregularity of the Peninsula’s coastline, a tsunami’s effects would vary geographically. Along the Chesapeake Bay coastline, the effect would be similar to that of a nor’easter at high tide, with shoreline erosion and damage to docks and piers. Other effects would be beach erosion, dune and seawall overwash, coastal flooding and damage to low-lying properties. Along inner creeks and rivers that narrow in width inland, flooding would be amplified as the wave is confined to a more narrow space (MGS, 2005).

Although earthquake-driven tsunamis pose some risk to the Peninsula, another source of tsunami action exists closer to home. Driscoll and others (2000) documented a large submarine landslide off the coast of Virginia. The Albemarle-Currituck Slide occurred approximately 18,000 years ago, involving over 33 cubic miles of material which slid seaward from the edge of the continental shelf, most likely causing a tsunami. Cracks in the continental shelf exist in this area, which may indicate slope failure and potential for another submarine landslide and subsequent tsunami of several meters in height. Impacts from a tsunami of this height would be similar to storm surge from a Category 3 or 4 hurricane.

4.1.17 Sea Level Rise

While not specifically called out in discussions with the PHMPC when identifying the natural hazards that the Peninsula faces, sea level rise can be expected to have an impact, over time, in the region. Because much of the coastal land area in the region lies at elevations at or below 7 feet MSL, any increase in the mean low water level of the Chesapeake Bay and surrounding tidal rivers and estuaries has a direct impact on coastal lands. These impacts may include the potential for increased erosion, loss of coastal zone lands, including wetlands, and a potential for increased damages from coastal storms.

Research conducted by NOAA indicates that, during the period 1854 to 1999, sea level in the Chesapeake Bay region has risen from 1.30 to 1.45 feet (NOAA 2001). The rising sea level trend is attributed to two primary sources: a slow, gradual rise in ocean levels, and land subsidence caused primarily by natural geologic processes and, in localized areas, by groundwater withdrawal (Boesch *et al*, undated). By weighing the impact of future potential sea level rise, as well as the future storm impacts when making future land use decisions, the region has the opportunity to take a more proactive approach to regulatory protections. Sea level rise can be expected to continue through the foreseeable future, which warrants continued vigilance at the local level; however, reducing the rate of sea level rise is outside the realm of local control (Boesch *et al*, undated).

Protecting tidal structures and wetlands may mean more active management at the local level, including techniques to ensure adequate elevation of structures and adequate erosion and sediment control measures. FEMA estimates that at the rate of sea level rise experienced on average around the coastal United States, roughly 12 inches per century, the number of households subject to flooding would increase from about 2.7 million now to almost 6 million by 2100 as a result of the combination of sea level rise and projected coastal population growth (Office of Technology Assessment, 1993). Over time, sea level may also change the physical characteristics of the region's floodplains. One way in which Peninsula communities may wish to address this gradual threat is by examining floodplain management ordinances to consider the inclusion of a one-foot or more freeboard requirement for new development or substantial improvements in the floodplain.

Sea level rise further exacerbates coastal erosion by causing the boundary between land and water to recede and move inland.

4.1.18 Critical vs. Non-critical Hazards

Based on readily available data, local knowledge, and observations, the PHMPC performed a two-stage evaluation of above-mentioned hazards utilizing the Natural Hazard Ranking Sheet (Appendix D). First, they grouped the hazards into two categories: critical and non-critical hazards (Table 4.1.17).

> **Critical hazards:** those hazards in which historical data exist to document impacts that have resulted in significant losses to the Peninsula region and its citizens. Critical hazards are those natural hazards that occur with little or no warning and have the possibility to create such widespread destruction that resources from outside the jurisdiction would be required to respond or recover.
>
> **Non-critical hazards:** those hazards that have occurred very infrequently or have not occurred at all in the historical data. They are not considered a widespread threat resulting in significant losses of property or life. Non-critical hazards also include hazards that occur frequently (on average every year) and those that the jurisdiction is equipped to mitigate.

Secondly, the PHMPC, in conjunction with the consulting team, ranked each critical hazard based on the threat posed to its citizens (Table 4.1.17). Hazards that ranked critical with a medium to high hazard level were then investigated further and a vulnerability analysis was performed for affected communities.

Table 4.1.18 -Hazard Identification Results

Hazard type	Non-Critical/Critical	Hazard Level
Flooding	Critical	High
Hurricanes	Critical	High/Medium
Tornados	Critical	Medium
Wildfire	Critical	Medium
Nor'easters	Critical	Medium/Low
Winter storms	Critical	Medium/Low
Drought	Non-Critical	Low
Earthquakes	Non-Critical	Low
Biological Hazards/Epidemics	Non-Critical	Low
Thunderstorms	Non-Critical	Low
Dam Failure	Non-Critical	Low
Extreme Heat	Non-Critical	Low
Expansive Soils	Non-Critical	Low
Landslides	Non-Critical	Low
Sea Level Rise	Non-Critical	Low
Tsunamis	Non-Critical	Low

5.0 Community Specific Profiles

The previous section addressed general hazard information as it applies to the entire Peninsula region. The following sub-sections address critical hazards that have a significant recurrence interval that is measurable, and a known hazard history. These sections describe the history of occurrence, vulnerability assessment for a particular hazard, and the community capability analysis for addressing these natural hazards.

A vulnerability assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from hazard events. The assessment provides the foundation for the rest of the mitigation planning process by defining and quantifying various problems. The assessment process focuses attention on vulnerable areas with the greatest needs by evaluating populations and facilities that are most vulnerable to community specific hazards and to what extent injuries and damages may occur (FEMA, 2001). The risk assessment process allows a community to better understand potential risk and associated vulnerability to hazards.

The planning team developed the natural hazard risk assessment for each member jurisdiction in three main steps: 1) hazard analysis, 2) vulnerability assessment, and 3) capability assessment. This information provides the framework for the PHMPC to develop and prioritize mitigation strategies and plans to reduce the risks and vulnerabilities that the region's communities may encounter from future hazard events.

The multiple-hazard identification and risk assessment processes evaluate the location, extent, magnitude, probabilities, and likelihood of the occurrence of hazards. While there are many hazards that could potentially affect the region, certain hazards are more likely to cause significant damage than others. This analysis attempts to measure these potential impacts and identify the hazards that create the greatest possible risks.

The second phase in this process is the vulnerability assessment, which estimates the extent of injury and damages that may result from a hazard that occurs within the member jurisdiction. The vulnerability assessment also examines the region's existing and future land uses, development trends, and demographics within the identified hazard areas, so that the impacts of future disasters can be lessened.

The third phase of this process includes the capability assessment. The capability assessment will provide the member jurisdiction with a better understanding of preparedness levels and capability to mitigate against natural hazards.

The capability analysis is a key element in developing suitable goals and objectives for mitigation. Because mitigation is most effective at protecting development that does not yet exist, a community's development trends can provide direction, incentive and alternatives to placing new development at risk from natural hazards. Furthermore, a careful analysis of existing capabilities increases the likelihood of identifying practices that could potentially *increase* the impacts of hazards upon the communities. A properly conducted mitigation capability assessment can also demonstrate potential gaps that hinder mitigation programming or highlight policy needs that could enhance mitigation programming.

Each community's capability with regard to natural hazard mitigation was examined through interviews with key personnel, data collection, and examination of regulations. The following sample matrix was completed for each of the five Peninsula communities, and was used to trigger discussion about existing policies, regulations, and processes for numerous hazards.

Table 5- Capability Matrix (Example)

	Town of HAZARDVILLE
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	Yes
-Effective Flood Insurance Rate Map Date	22-July-77
-Substantial Damage Language	Yes
-Certified Floodplain Manager	No
-Number of Flood-prone Buildings	0
-Number of NFIP policies	0
-Maintain Elevation Certificates	No
-Number of Repetitive Losses	0
CRS Rating	No
Stormwater Program	Yes
Building Code Version Full-time Building Official	USBC 2000 Edition (based on IBC)
- Conduct "As-built" Inspections	Yes
- BCEGS Rating	TBD
Local Emergency Operations Plan	Yes
Hazard Mitigation Plan	
Warning Systems in Place	Yes
-Storm Ready Certified	No
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	Yes
-Emergency Notification (R-911)	Yes
-other (e.g., cable override)	Yes-Cable-Emergency Alert System
GIS system	No
-Hazard Data	N/A
-Building footprints	N/A
-Tied to Assessor data	N/A
-Land Use designations	N/A
Structural Protection Projects	No
Property Owner Protection Projects	Acquisitions
Critical Facilities Protected	No
Natural Resources Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

Explanation of Sample Capability Assessment Matrix (as shown in Table 5)

Comprehensive Plan: Comprehensive Long-Term Community Growth Plan
Land Use Plan: Plan that designates type of land use desired/required for individual parcels; often based on Zoning.
Subdivision Ordinance: Regulations that dictate lot size, density, setbacks, construction type and other parameters for large developments.
Zoning Ordinance: Regulations that dictate acceptable uses for individual parcels; may be tied to Land Use Plan.
Floodplain Management Ordinance: Directs development in identified Flood Hazard Areas. Required for participation in NFIP.
Substantial Damage Language: Provision of Floodplain Management Ordinance requires existing construction be brought into compliance if structure is damaged/improved by more than fifty percent of its value.
Certified Floodplain Manager: Association of State Floodplain Managers' designation for professionally certified floodplain managers.
Number of Flood-Prone Buildings: Number of buildings in the mapped Special Flood Hazard Area.
Number of NFIP policies: Number of buildings insured against flood damage through the NFIP.
Number of Repetitive Losses: Number of properties with multiple flood insurance claims in past ten years.
CRS Rating: Community Rating System of the NFIP is an incentive program that rewards communities for regulations/programs that exceed NFIP minimums through premium reductions for insured.
BCEGS: Building Code Effectiveness Grading System Rating assesses the building codes in effect and how they are enforced, with special emphasis on mitigation of losses from natural hazard.
Emergency Operations Plan: Disaster Response Plan focuses on different disaster types and scenarios.
Hazard Mitigation Plan: Plans such as this may address different types of hazards, including natural hazards, man-made hazards, others as defined by a particular jurisdiction.
Warning: Warning systems in place in a community, including NOAA Weather Radio reception, outdoor sirens, Cable Override, Flood Warning System, or Emergency Warning Notification System.

GIS: Geographic Information System, or geographic databases interfaced with community mapping to provide enhanced planning and response capability.
Structural Protection Projects: Constructed flood protection, such as levees, drainage facilities, detention/retention basins.
Property Protection Projects: Non-structural flood protection through acquisition, elevation of structures, or flood proofing.
Critical Facility Protection: Previous community projects to protect critical facilities May include protection of power substations, sewage lift stations, water-supply sources, the EOC, police/fire stations or medical facilities.
Natural and Cultural Inventory: Inventory of resources, maps, or special regulations to protect natural or cultural resources; examples include wetlands, steep slopes or historic structures.
Erosion or Sediment Control: Regulations to protect streams and waterways from sediment contributions originating from construction, runoff, or other sources.
Public Information or Environmental Education Program: Ongoing programs providing information to the public on hazards, environmental awareness, and emergency preparation. May include flyers in city utility billings, a website, or an environmental education program for students.

The mitigation capabilities of each community are individually identified and included as part of each community profile.

5.1 City of Hampton Profile

The following sections present a detailed assessment of critical hazards that affect the City. Understanding these hazards will assist the Peninsula region in its process of identifying specific risks and developing a mitigation strategy to address those risks.

5.1.1 Flooding – City of Hampton

The City of Hampton's geographic location makes it extremely susceptible to coastal flooding. Storms associated with coastal flooding include tropical cyclones and nor'easters. These types of events typically drop large amounts of rain and generate high winds that result in storm surge. Storm surge is the water that is pushed toward the shore by the persistent force of the winds of an approaching storm. Astronomical tides occur independently of climactic conditions. Depending on the tide level at the time of landfall, storm surge may be elevated due to high tides or spring high tides. Flash flooding and urban flooding are also a concern within the city limits.

As part of the NFIP, FEMA has created a Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for the City of Hampton, dated July 16, 1987. The NCDC tracks the occurrence of flooding events for communities across the nation. The City of Hampton has developed surge elevations for its parcel data set. All of these data sources were utilized in developing this hazard identification and vulnerability assessment.

The FIRMs, which accompany this FIS, delineate the 100- and 500-year flood hazard boundaries for flooding sources identified in areas of growing development or areas predicted to have future development, at the time of the report. A detailed wave height analysis was developed in order to delineate the 100- and 500 year flood hazard boundaries for the city. The 100-year flood has a one percent chance of occurrence of being equaled or exceeded in any given year; a 500-year flood has a 0.02 percent annual chance of occurrence. This analysis resulted in a 100-year stillwater elevation of 8.5 feet for Hampton, and a maximum 100-year wave crest of 11 to 13 feet. The full FIS provides a detailed description of methods and assumptions. The significant flood events outlined in the FIS are provided below in Table 5.1.1a.

Table 5.1.1a -Significant Flood Events

City of Hampton Flood Insurance Study

Date	Storm	High Water Elevations
August 1933	Chesapeake - Potomac Hurricane	Max tide heights averaged 8 feet
April 1956	Nor'easter	Not provided
October 1957	Hurricane – Not named	Not provided
September 1960	Hurricane Donna	Not provided
March 1962	Nor'easter, Ash Wednesday Storm	Max tide heights averaged 6.8 feet

Source: FEMA 1987

The NCDC, operated by NOAA, keeps a record of significant weather related events and damage estimates for the entire country. Listed below are the most significant events that have affected the City of Hampton since the FIS was developed (1987); (Table 5.1.1b).

Table 5.1.1b - NCDC Significant Flood Events –City of Hampton

Date	Event	Precipitation	Comments
September 15 to 17, 1999	Hurricane Floyd	12-18 inches	▪ Numerous roads washed out due to flooding ▪ Flooding considered 500-year flood ▪ Enormous crop damage
October 17 to 18, 1999	Hurricane Irene	4-7 inches	▪ Numerous flooded roads and road closures
July 24, 2000	Flash Flood	Torrential Rain	▪ Up to 35 residences had to be evacuated due to high water
June 14, 2002	Flash Flood	Not provided	▪ Numerous reports of street flooding ▪ Water shooting out of manholes
August 28, 2002	Flash Flood	2 to 3 inches in 3 hours	▪ Caused road closures
September 3, 2003	Flash Flood	Not provided	▪ Many roads flooded
September 18, 2003	Hurricane Isabel	4-7 inches	▪ Severe Flooding ▪ Trees down ▪ Power Outage
August 30, 2004	Tropical Storm Gaston	Not provided	▪ Flooding occurred in the city

5.1.2 Hurricanes – City of Hampton

Virginia felt the effects of over 20 major hurricanes since the early 20th century. Most recently, the communities within the Peninsula area were damaged by Hurricanes Dennis and Floyd in September 1999 and Hurricane Isabel in September 2003.

Hurricane Dennis set the stage for its successor, Hurricane Floyd, by deeply saturating the soil throughout the Peninsula. An erratic Dennis lingered off the North Carolina coast for several days between August 31 and September 5, 1999, dumping 3.3 inches of precipitation at Norfolk Airport, with even higher totals inland. Shortly thereafter, on September 16, Hurricane Floyd moved through the Peninsula area dropping four to five inches of rain within 24 hours and generating winds in excess of 40 mph. Storm precipitation in Hampton totaled 7.5 inches, and throughout the Peninsula, trees and power lines were knocked down, roads flooded, and over 5,500 homes were left without power. The havoc produced by the two events in such short succession surely amplified their effects.

Hurricane Isabel made landfall on September 18, 2003 as a Category 2 hurricane near Drum Inlet, North Carolina. Hurricane Isabel is considered to be one of the most significant tropical cyclones to hit this area since Hurricane Hazel (1954) and the Chesapeake-Potomac Hurricane of 1933. Isabel produced storm surges 6 to 8 feet above normal high tide levels and was directly responsible for 10 deaths in Virginia and indirectly responsible for 22 deaths. Isabel caused widespread wind and storm surge damage in eastern North Carolina and southeastern Virginia, currently estimated at $925 million in Virginia. All of the above data was taken from the NOAA Tropical Cyclone Report for Hurricane Isabel (Beven and Cobb, 2004).

Coastal flooding from Isabel at Buckroe Beach, Hampton

In Hampton, the Buckroe and Grandview areas were particularly hard hit by Isabel. In Grandview, estimates of at least $4 million damage to older 1940s style homes and cottages were reported, with the majority of the older homes being significantly damaged or destroyed. (FEMA 2004) Isabel's storm surge exceeded the 1933 surge in some areas, and fell short in others. At King Street and Mercury Boulevard, the Isabel surge was at least two feet shy of the 1933 storm, but at Ft. Monroe, the storm surge in 2003 was at least 2.5 feet higher. At Fox Hill, Isabel brought an additional 12 inches of surge to the area. Forecasters at the National Hurricane Center in Miami attributes Isabel's wrath to the fact that the storm's right front quadrant lashed the Peninsula and the wind stayed out of the east for an extended period, resulting in water piling up in the extended reaches of many rivers and creeks. Much of the damage from felled trees in Isabel can be attributed to the immense precipitation experienced prior to September 2003; the summer of 2003 had nearly two times the total prior to the 1933 storm. (*Daily Press*, 8/23/03, *Daily Press* 9/29/03)

5.1.3 Tornados – City of Hampton

The City of Hampton has experienced four tornados over the period of 1979 to 2004 (Table 5.1.3), which have caused a variety of damage. The four tornados identified on the NCDC dataset consisted of one F0 and two F2s. The most significant tornado, an F2, occurred on

September 4, 1999, preceding Hurricane Dennis. This tornado caused extensive structural damage to a three block area. As a result, fifteen people were injured (six seriously) and three apartment complexes and an assisted living facility were condemned. Total damages were estimated at $7 million. No crop damage was reported.

A tornado struck Newport News a little past 3 p.m. on August 6, 1993. A man on the James River Bridge saw three funnel clouds over the river. Two dissipated and the third touched down moving through the woods on the Newport News side of the river. The tornado tracked 12 miles through Newport News, Hampton and Langley Air Force Base. In Hampton, two people were injured, 85 homes were damaged, 8 condemned with damage costs near three-quarters of a million dollars. On Langley, the tornado damaged several F-15s parked at the end of a runway for an air show scheduled for the next day

Table 5.1.3 - Historic Tornados – City of Hampton

Date	Magnitude	Deaths	Injuries	Property Damage	Descriptions
September 5, 1979	F2	0	9	$250,000	• Unroofed a home and damaged 27 others (Watson 2004c) • Spawned by Hurricane Davis (Watson 2004c)
August 6, 1993	Not reported	0	2	$750,000	• 85 homes damaged; 8 condemned • F-15s at LAFB damaged
September 4, 1996	F0	0	1	$1,000	• Minor damage
September 4, 1999	F2	0	6	$7.7 million	• Extensive structural damage to 3 block area • 3 apartment complexes and 1 assisted living complex condemned • 2 additional apartment complexes partially condemned • 460 persons forced to evacuate • 800 vehicle damaged • Occurred ahead of hurricane Dennis
August 30, 2004	Not reported	0	0	Not reported	• Minor tornado from Gaston

5.1.4 Wildfire – City of Hampton

Many wildfires are caused through human acts, both intentional (i.e. arson) and accidental. They can also be started through natural occurrences, such as lightning strikes. Wildfire danger can vary greatly season to season and is often exacerbated by dry weather conditions. Because of wild fire risk, VDOF has provided new information on identifying high-risk fire areas. Their Fire Risk Assessment Map was designed to help communities determine areas with the greatest vulnerability to wildfire.

The proximity of the tree lines or brush to the highway or roadway is also included in the wildfire risk analysis to capture the human/wildfire causal relationship. Travel corridors increase the probability of human presence across a landscape, thereby increasing the probability of wildfire ignition. As such, areas closer to roads are much more likely to attain a higher ignition probability. (NWUIFPP updated).

The Wildfire Risk Assessment Map in Appendix B, as well as the large-format Multi-Hazard Map for Hampton attached to this report, delineates the aerial extent of wildfire vulnerability within the City of Hampton, based on VDOF fire risk assessment data. Parameters used to establish these risk boundaries are land use, population density, slope, land cover and proximity to roads. The map shows that approximately seven percent of the city is located in the high wildfire risk zone. No fire incidences have been reported with the city limits by the VDOF for the time period of 1995-2003.

5.1.5 Vulnerability Assessment – City of Hampton

The PHMPC conducted a vulnerability analysis for each natural hazard that was identified as critical with medium to high hazard potential. These hazards include: flooding, hurricanes, tornados, and wildfire. This section describes the methodology used to perform the vulnerability analysis for each hazard and then lists the results of this analysis. The vulnerability assessment investigated the following:

- Number and value of at risk structures;
- Number of at risk critical facilities; and,
- Extent of at risk critical infrastructure.

Flooding – City of Hampton
The City GIS Office provided a digital parcel polygon layer containing attribute fields that included a FEMA flood hazard designation and improvement values. This database was queried to determine which parcels were within 100-year flood hazard boundaries. The improvement values of these parcels were then totaled.

From the vulnerability analysis it was determined that 11,120 parcels are designated as Zone AE, 348 parcels were designated as Zone VE, and 23 were designated as Zone A. All of these zones represent the one percent annual chance (100-year) flood hazard as defined by FEMA. There were a total of 50,252 parcels in the database. The analyses found that approximately 23 percent of these parcels are designated with 100-year flood hazard. The City assessor's database provided by the city included a general designation for each parcel, indicating "dwelling", "commercial", "other" or "no value". Table 5.1.5a provides a summary of the analysis.

Table 5.1.5a - Summary of Flood Analysis – City of Hampton

Parcel Designation	Number of Parcels	% of Total Land Area	Parcels in 100-yr Floodplain	Improvement Value
Dwelling	42,056	84	10,815	$1,124,810,600
Commercial	1,977	4	391	$2,067,112,700
Other (*e.g.,* boathouse, garage)	538	1	285	$20,001,300
No Value/Vacant	5,681	11	N/A	N/A
Total	**50,252**	**100**	**11,491**	**$3,211,924,600**

FEMA developed a concept to highlight the impact that repetitively flooded structures have had on the NFIP. The term "repetitive loss," as applied to the NFIP, refers to any property for which two or more flood insurance claims in excess of $1,000 each in a 10-year period of time have been paid. In 1998, FEMA reported that the NFIP's 75,000 repetitive loss properties had already cost $2.8 billion in flood insurance payments and numerous other flood prone properties continue to remain at high risk in the Nation's floodplains. While these properties make up only one percent of the flood insurance policies currently in force, they account for 30 percent of the country's flood insurance claim payments. A report on repetitive loss structures completed by the National Wildlife Federation found that 20 percent of these structures are listed as being outside of the 100-year floodplain (Conrad et al. 1998).

FEMA has identified 160 structures as repetitive loss structures in the City of Hampton. The structures are valued at over $19.5 million, collectively. Losses span the time period from April 1978 through September 2003 (Hurricane Isabel). Total flood insurance payments for buildings and contents over that period are $6.6 million, or 18 percent of the total payments made to all Hampton properties in that time. City planners have identified specific areas of the city that contain large numbers of repetitive losses; however, in order to protect the privacy of those policyholders, that information cannot be shared in this plan.

Hurricane – City of Hampton

Hazards U.S. – Multi Hazard (HAZUS$^{®MH}$) was utilized to perform a wind hazard analysis for the entire Peninsula region. HAZUS$^{®MH}$ software is a multi-hazard loss estimation program that was developed under a cooperative agreement between the National Institute of Building Sciences and FEMA. The current version of HAZUS$^{®MH}$ has the ability to calculate earthquake, wind, and flood hazards as well as potential economic losses associated with these hazards. The software is designed with the flexibility to perform loss estimations at three different levels. Level 1 utilizes all default parameters built into the software. Levels 2 and 3 require user-defined scenarios and building inventory data. For the purposes of this plan, a Level 1 wind analysis was performed to calculate the wind hazard for Hampton. The probabilistic scenario was used for this analysis. This scenario activates a database of many thousands of storm tracks and intensities, and generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year.

Table 5.1.5b lists the total dollar value of exposed structures for the City of Hampton. The default data set provided with the HAZUS$^{®MH}$ software is based on the 2002 U.S. Census data. This analysis is based on the probability of occurrence and can generally be used to estimate potential damages from high winds despite development trends that may have impacted population since 2002.

Table 5.1.5b-Value of Structures Exposed to High Wind – City of Hampton

Occupancy Type	Total Value of Exposed Structures (in $1,000)
Residential	$7,243,284
Non-Residential	$1,100,057
Total	**$8,343,341**

Based on HAZUS$^{®MH}$.

The probabilistic analysis generated with the HAZUS$^{®MH}$ software utilized the same building stock information listed in Table 5.1.5a. The probabilistic scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year. The probabilistic method was used to generate loss estimations of storms with specific recurrence intervals: 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year. Since residential structures comprised a significantly large percentage of the occupancy classification, these data are presented in Table 5.1.5c below.

Table 5.1.5c-Summary of Probabilistic Analysis – Residential Structures – City of Hampton

Return Period	Residential Building Damage – Number of Buildings			
	Minor	Moderate	Severe	Destruction
10-year	42	4	0	0
20-year	449	48	9	0
50-year	6,069	1,034	148	35
100-year	12,906	4,896	1,057	739
200-year	15,238	7,334	1,816	1,273
500-year	14,693	11,004	4,457	3,632
1000-year	10,263	12,075	8,424	8,798

A consistent problem with these data is evident here, and that is that NOAA, USACE and HAZUS-MH do not provide a clear relationship between return periods and categories of hurricanes.

Tornado – City of Hampton

Four tornado events were reported for the City of Hampton. The random nature of these events renders them difficult to predict; therefore, conducting a vulnerability analysis is difficult. The entire city has equal statistical probability of experiencing a tornado. Historic occurrences of tornados in the region show the severity of tornados typically range from F0 to F3 on the Fujita Scale, but the likelihood of a bigger tornadic event cannot be discounted.

The facilities and building stock that were identified as exposed under the hurricane hazards above are also exposed to tornado hazards. Tornados are random natural events that strike with little warning but are associated with thunderstorms and tropical weather such as hurricanes.

Wildfire - City of Hampton

The Wildfire Risk Assessment data, provided by the VDOF, was utilized to estimate the wildfire risk for the City of Hampton. The Wildfire Risk Map (Appendix B) shows that approximately seven percent of the city is in a high risk area. This data layer was overlaid with the city parcel mapping in order to estimate the value of at-risk structures. The VDOF also provided the number of wildfire incidences reported from 1995-2003.

According to the VDOF, zero incidences of wildfire were reported for the City of Hampton from 1995-2003. There are 456 parcels that intersect the high wildfire hazard zone. The parcels have a total improvement value of $986,342,500.

Critical Facilities Analysis – City of Hampton

In order to assess the vulnerability of a community to natural hazards, the PHMPC conducted an inventory of the Peninsula area structures and critical facilities (Appendix E). Critical facilities are those facilities that warrant special attention in preparing for a disaster and/or facilities that are of vital importance to maintaining citizen life, health, and safety during and/or directly after a disaster event.

The inventory of critical facilities for the City of Hampton includes emergency response facilities such as police stations, fire departments, emergency medical service stations (EMS), public facilities including schools and local government buildings. The code and number provided in Table 5.1.5f identify these facilities on the all-hazard mapping provided in Appendix F. Those facilities that are geographically located within an identified hazard zone are listed in Tables 5.1.5d, 5.1.5e, and 5.1.5f.

Table 5.1.5d -Critical Facilities at Risk – 100-Year Floodplain

Name	Code	Number
Station 5	FR	10
Fire Administration	FR	12
Fire Training Center	FR	13
Police Headquarters	PO	4
Police Field Office	PO	6
Gloria Dei Lutheran School	SC	9
Syms Middle School	SC	34
Burbank Elementary School	SC	42
Cooper Elementary School	SC	1
Tyler Elementary School	SC	38
Barron Elementary School	SC	44
Spratley Middle School	SC	32
Mary Peake – Y.H. Thomas Center	SC	20
Tarrant Elementary School	SC	35
Wythe Elementary School	SC	40

Source: AMEC
Critical Facility Key Code, see Appendix E

Table 5.1.5e-Critical Facilities at Risk –Surge Zone Hurricane Category 4

Name	Code	Number
Station 9	FR	3
Station 3	FR	8
Sentara Careplex	HO	3
Kecoughtan Court	PO	8
Briarfield	PO	9
New Horizon Regional Education Center	SC	23
Hampton High School	SC	11
Robert E Lee Elementary School	SC	29
New Mount Olive Christian Academy	SC	24
Lindsay Middle School	SC	17
Bassette Elementary School	SC	51
Emmanuel Grace Baptist Church	SC	4
Bradford Hall	SC	53
Wythe Elementary School	SC	40

Source: AMEC
Critical Facility Key Code, see Appendix E

Table 5.1.5f-Critical Facilities at Risk - High Wildfire Hazard Zone

Name	Code	Number
Thomas Nelson Community College	SC	36
New Horizon Regional Education Center	SC	23

Source: AMEC
Critical Facility Key Code, see Appendix E

5.1.6 Capability Assessment – City of Hampton

As an additional tool to assist with the examination of the hazards identified and to evaluate the community's ability to plan, develop, and implement hazard mitigation activities, the planning team assessed Hampton's existing mitigation capabilities. This assessment is designed to highlight both the codified, regulatory tools available to the community to assist with natural hazard mitigation as well as other community assets that may help facilitate the planning and implementation of natural hazard mitigation over time. The following Capability Assessment Matrix was used as a basis for the City of Hampton's mitigation plan.

Table 5.1.6 - Capability Matrix – City of Hampton

	City of Hampton
Comprehensive Plan	Yes, 12/89
Land Use Plan	Yes, part of Comp. Plan
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	Yes
-Effective Flood Insurance Rate Map Date	7-3-95
-Substantial Damage Language	Yes
-Certified Floodplain Manager	No
-Number of Floodprone Buildings	11,491
-Number of NFIP policies	9,792 (85%) as of 6/04
-Maintain Elevation Certificates	Yes
-Number of Repetitive Losses	160
CRS Rating	none
Stormwater Program	Yes
Building Code Version Full-time Building Official	VUSBC (IBC 2003) Yes
- Conduct "As-built" Inspections	Yes
- BCEGS Rating	2
Emergency Operations Plan	Yes
Hazard Mitigation Plan	Pending
Warning Systems in Place	Yes
-Storm Ready Certified	Yes
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	No
-Emergency Notification (R-911)	Yes
-other (e.g., cable override)	Yes – cable override
GIS system	Yes
-Hazard Data	Yes
-Building footprints	Yes

	City of Hampton
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	Yes
Property Owner Protection Projects	Yes
Critical Facilities Protected	Not all facilities fully protected.
Natural Resources Inventory	No
Cultural Resources Inventory	Yes, partial inventories
Erosion Control Procedures	Yes, by State law
Sediment Control Procedures	Yes, by State law
Public Information Program/Outlet	Yes, Emerg Mgmt & Public Works & CERT
Environmental Education Program	Yes, Public Works

Form of Governance

Hampton has a Council – Manager form of government. The Hampton City Council is composed of seven elected members, including an elected Mayor. The Council selects the Vice Mayor after each election. Elections are held on the first Tuesday in May. Council members are elected to four-year terms in staggered elections in even years. The Council appoints a City Manager who administers day-to-day city services and directs city agencies.

Guiding Community Documents

The City of Hampton has a range of guidance documents and plans for each of their departments. These include a comprehensive plan, 15 neighborhood/small area plans, capital improvement plans, and emergency management plans. The City uses building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the municipality guides its future is through policies laid out in the Comprehensive Plan.

Comprehensive Plan 2010

The Code of Virginia requires all cities and counties in the state to have a comprehensive plan and to review it every five years to determine if revisions are necessary. The City of Hampton's *Comprehensive Plan 2010* was adopted in 1989 and is the responsibility of the Department of Planning. The document features the following:

- The plan presents long-range intentions regarding the direction and nature of future development, assesses current conditions and incorporates citizen desires into long-range public policy.
- Comprised of six elements that focus on aspects of future development: Land Use, Transportation, Community Facilities, Environment, Housing, and Urban Design.
- Environmental element focuses on Chesapeake Bay water quality, balancing environmental restraints and development needs, stormwater management, protecting and enhancing water access, and the need for inventories of significant natural resources.
- Plans for continued growth and development and urban design in designated growth/redevelopment areas, including:

  - o Coliseum Central
  - o Downtown Hampton
  - o Buckroe Beach
  - o King Street Corridor
- Plans for necessary transportation enhancements and improvements to service projected growth
- Plans for operation and expansion of public facilities to accommodate expected growth in the City, including bikeways, playgrounds, and pools.
- The City is currently working to adopt a new ten year plan, *the City of Hampton Community Plan*. This plan will be adopted in the Fall of 2005.

Zoning & Development Standards

- Identifies existing federal and state regulations for wetland, floodplain, and RPA/RMA protection.
- The document outlines required standards for new development and redevelopment based on use and zoning designation.

The City of Hampton has adopted the minimum requirements of the NFIP by designating the Flood Zone District as a Special Public Interest District in Zoning Ordinance §17.3-31. The community has 160 repetitive losses through the NFIP, 15 of which were constructed after the community's flood hazard areas were mapped (post-FIRM). Structures in A Zones must be constructed at or above the Base Flood Elevation, and structures in V-Zones must have their lowest horizontal structural member elevated to or above the base flood elevation, which includes an additional three feet for wave height. The Department of Codes Compliance enforced requirements for "substantially damaged" homes after Hurricane Isabel, but the process was exceedingly difficult and some difficult decisions had to be made. The City's Building Permit application includes a notation regarding the map panel and zone designation, and a space for the Finished Floor Elevation. Permit applications and parcel information are all available online. The parcel information includes flood hazard area designation.

A Site Plan Review Committee for new development is made up of representatives from Public Works, Division of Fire and Rescue, Police Division, Planning Department, Codes and Compliance, and any other department that the Director of Public Works deems necessary to review proposed plans. During the review of new site plans, recommendations concerning the plan may be made and any such suggestions shall be reported to the City Manager when the plan is submitted for review. The committee is tasked with the responsibility of reviewing the plan to ensure its compliance with the City's building, structure, and safety codes. The Police Division is tasked with ensuring that Crime Prevention through Environmental Design (CPTED) is achieved. This is accomplished by ensuring appropriate lighting and landscaping design, while minimizing design barriers that may result in unsafe or unlawful activities. The Office of Emergency Management is not involved in the Site Plan Review Committee.

Stormwater Program and Fees

The City's stormwater fee is a result of the Federal Clean Water Act of 1987, which mandated that cities of 100,000 or more persons reduce pollution before it reaches the Chesapeake Bay. Hampton established the stormwater fee because no Federal or state dollars were provided to implement water quality measures in accordance with the Federal mandate.

Monies from the stormwater fee are used to fund many programs related to water quality including environmental education, street sweeping, capital improvements to the system, drainage maintenance, administration, review of permits, inspection, and monitoring activities.

Public Education

Among the readily available public outreach mechanisms for the City of Hampton, the City's website (http://www.hampton.gov) provides residents with pertinent information, provides an on-line complaint form, property information tool, and answers numerous Frequently Asked Questions (FAQs). The City also posts most of its guiding documents, including the Comprehensive Plan on this site. The City provides special training to property owners via the Codes Academy and the City's Neighborhood College Leadership Institute. Emergency Preparedness information is also disseminated through the City PIO's eNews, free e-mail briefs about what's happening in Hampton, and the City's local cable channel, Channel 47.

The City of Hampton is the first locality in Virginia to establish a centralized 3-1-1 customer call center that offers citizens round-the-clock access to city services and information. Residents within the city limits dial 3-1-1 and reach the voice of call center staff. Residents with cell phones may also access 3-1-1. Those citizens outside of the city limits may access the customer call center by calling 727-8311. Customer Advocates (call-takers) help with everything from reporting a missed trash collection to potholes to answering questions about the city budget or inquiries about a community center's hours.

The City's Department of Public Works has many different types of educational materials available for Hampton residents, businesses, teachers, youth, and adult groups. Materials may include coloring books, posters, promotional magnets, environmental tip sheets, and guides to all environmental services in Hampton. The Hampton Watershed Restoration Project offers annual waterway clean-ups, Chesapeake Bay friendly seminars, Adopt-a Stream cleanup, storm drain marking, environmental ambassador efforts and public education activities.

Emergency Preparedness

Emergency Alert System (EAS) is a national civil emergency alert system that uses message relays between member radio and television stations to inform the public about immediate threats to national security, life, and property. EAS is used for severe weather warnings and can also be employed to disseminate Amber Alerts for missing children. The enhancement is an initiative of Governor Warner's Secure Virginia Panel designed to improve statewide preparedness, response, and recovery capabilities for emergencies and disasters. Governor Mark R. Warner announced June 5, 2004, that Virginia will enhance its public warning capabilities with a new satellite-based system that can rapidly transmit EAS messages throughout the Commonwealth.

Storm Ready – As of February 2005, the National Weather Service has certified only five Virginia communities as "Storm Ready", including Hampton, Newport News, Danville, Fairfax County and Loudoun County. Storm Ready is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle severe weather. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations. To be officially Storm Ready, a community must:

- Establish a 24-hour warning point and emergency operations center;
- Have more than one way to receive severe weather warnings and forecasts and to alert the public;
- Create a system that monitors weather conditions locally;
- Promote the importance of public readiness through community seminars; and,
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

Hampton Citizen Corps – The Hampton Citizen Corps is part of the Virginia Corps that creates opportunities for individuals to volunteer to help communities prepare for and respond to emergencies by bringing together local leaders, citizen volunteers and organizations. Hampton's Citizen Corps includes three core programs: Neighborhood Watch, Volunteers in Police Service (VIPS), and Community Emergency Response Team (CERT). Medical Reserve Corps (MRC) is under development.

CERT, which is the core program most relevant to hazard mitigation, helps communities respond to disasters during the first 72 hours following an event when flooded roads, disrupted communications, and emergency demand outweigh local emergency services. The purpose of CERT training is to provide private citizens with basic skills to handle virtually all of their own needs and then to respond to their community's needs in the aftermath of a disaster.

Other Mitigation Activities

Prior to Hurricane Isabel, placement of the geotube and beach nourishment at the north end of Buckroe Beach was the largest flood mitigation project financed by the City. Since 2001, the City has purchased eight inland structures in Buckroe with plans to install a dry stormwater pond in the area. One fire station remains in the floodplain (Fox Hill Fire Station, engine bay only), and at least one substation is located in the floodplain in the Fox Hill area.

Since Hurricane Isabel (September 2003), approximately 12 scattered residential structures have been elevated to at least the Base Flood Elevation with homeowner financing and Increased Cost of Compliance (ICC) funds. The City's Codes Compliance Department issued over 50 letters to homeowners providing eligibility for the NFIP's ICC program for insured structures. Two post-Hurricane Isabel FEMA HMGP project requests were submitted to elevate a total of 27 homes in Buckroe, Grandview, Chesapeake Avenue and the Coliseum Central areas. One grant has been approved, and the other denied. At the time of this report, the project is in the procurement phase. Several other HMGP projects have been proposed and rejected regarding relocating the school maintenance facility at Windmill Point, beachfront restoration at Buckroe Beach, seawall reconstruction at Chesapeake Avenue, and generator-wiring of critical facilities.

The City of Hampton plans to expand and improve Newmarket Creek Park. Newmarket Creek watershed has a significant history of flooding. The improved park will include additional designated open space in the floodplain, and additional canoe launches and docking areas in an effort to improve recreational access to local waterways.

The City's Household Chemical Collection Program is a drop-off program sponsored by the City of Hampton and the Virginia Peninsula's Public Service Authority (VPPSA) to serve residents in the City of Hampton for the disposal of household chemicals. This program helps remove aging hazardous chemicals from residences throughout Hampton, including areas that could be affected by flooding.

5.2 City of Newport News Profile

The following sections present a detailed assessment of critical hazards that affect the City of Newport News. Understanding these hazards will assist the Peninsula region in its process of identifying specific risks and developing a mitigation strategy to address those risks.

5.2.1 Flooding – City of Newport News

The geographic location of the City of Newport News makes it extremely susceptible to coastal flooding. Storms associated with coastal flooding include hurricanes and nor'easters. These types of events typically drop large amounts of rain and generate high winds that result in storm surge. Storm surge is essentially the water that is pushed toward the shore by the persistent force of the winds of an approaching storm. Astronomical tides occur independent of climactic conditions. Depending on the tide level at the time of landfall, storm surge may be elevated due to high tides or spring high tides. Flash flooding and urban flooding are also a concern within the City limits.

As part of the NFIP, FEMA created a Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for the City of Newport News. In addition, the NCDC tracks the occurrence of flooding events for communities across the nation. All of these data sources were considered in developing the hazard identification and vulnerability assessment.

FEMA published a FIS for the City of Newport News, dated January 17, 1986. The FIRMs, which accompany this FIS, delineate the 100- and 500-year flood hazard boundaries for flooding sources identified in areas of growing development or areas predicted to have future development, at the time of the report. A detailed wave height analysis was developed to in order to delineate the 100- and 500-year flood hazard boundaries for the City. This analysis resulted in a 100-year stillwater elevation of 8.5 feet for the City and a maximum 100-year wave crest of 11 to 13 feet. Refer to this report for a detailed description of methods and assumptions. The significant flood events outlined in the FIS are given below in Table 5.2.1a.

Table 5.2.1a-Significant Flood Events

City of Newport News Flood Insurance Study

Date	Storm	Tide Elevations
August 1933	Hurricane	Max tide heights averaged 8 feet
April 1956	Nor'easter	Not given
October 1957	Hurricane – Not Named	Not given
September 1960	Hurricane Donna	Not given
March 1962	Nor'easter	Max tide heights averaged 6.8 feet

Source: FEMA 1986

The NCDC, operated by NOAA, keeps a record of significant weather related events and damage estimates for the entire country. Listed below (Table 5.2.1b) are the significant events that have affected the City of Newport News.

Table 5.2.1b- NCDC Listed Significant Flood Events –City of Newport News

Date	Event	Precipitation	Comments
September 15 to 17, 1999	Hurricane Floyd	12 to 18 inches	▪ Numerous roads washed out due to flooding ▪ Flooding considered 500-year flood ▪ Enormous crop damage
July 19, 2000	Flash Flood	Not given	▪ Heavy rain caused flooding and road closures

5.2.2 Hurricanes – City of Newport News

The FIS for the City of Newport News identified two historic hurricanes that affected the City (see Table 5.2.1b above); however, specific damage estimates were not given. The NCDC dataset listed five hurricanes for the City of Newport News for the period between 1950 to June 2004. These storms are listed in Table 5.2.2.

Table 5.2.2- Historic Hurricanes – City of Newport News

Date	Storm Name	Category	Descriptions
August 15, 1995	Felix	Not provided	▪ No major damage reported in VA ▪ Tides 2.0-2.5 feet above normal
July 12, 1996	Hurricane	Not provided	▪ None given
September 1, 1999	Dennis	Hurricane/Tropical Storm	▪ Prolonged period of tropical cyclone ▪ Highest sustained winds at Langley 52mph ▪ Generated F2 tornado ▪ Tide 3 feet above normal ▪ Coastal flooding ▪ 2 to 5 inches of rain ▪ $27,000 damage
September 15, 1999	Hurricane Floyd	Category 1/Tropical Storm	▪ Spawned 2 tornados ▪ Hundreds of downed tress ▪ Tide 3.9 feet above normal ▪ Numerous roads washed out ▪ $99.4 million in property damage over the entire affected area ▪ Flooded portions of I-64 in Newport News ▪ Flooded townhomes near Newport News Park; water up to 2nd floor in some cases
September 18, 2003	Hurricane Isabel	Category 1/Tropical Storm	▪ Damaged residents and businesses ▪ Greatest storm surge since Hazel ▪ Thousands of uprooted trees ▪ Debris damage to homes ▪ Heavy rain caused flooding and road closures ▪ Power outage ▪ Water contamination

Hurricane Floyd moved through the area in September 1999, dropping 16.57 inches of rain within 24 hours and generating winds in excess of 50 mph in Newport News. Throughout the Peninsula, trees and power lines were knocked down, roads flooded, and over 5,500 homes were left without power. There was damage done to Interstate 64, and flooding along Kiln Creek, Newmarket Creek and Salters Creek.

I-64 flooding in Newport News from Hurricane Floyd

Hurricane Isabel made landfall on September 18, 2003, as a Category 2 hurricane near Drum Inlet, North Carolina. Hurricane conditions affected portions of southeastern Virginia. Rainfall averaged four to seven inches over large portions of eastern North Carolina as well as east-central Virginia. Hurricane Isabel is considered to be one of the most significant storms to hit this area since Hurricane Hazel (1954) and the Chesapeake-Potomac Hurricane of 1933. Isabel produced storm surges six to eight feet above normal high tide levels and is directly responsible for 10 deaths in Virginia and indirectly responsible for 22 deaths. Isabel caused widespread wind and storm surge damage in eastern North Carolina and southeastern Virginia, currently estimated at $925 million in Virginia. All of the above data was taken from the NOAA Tropical Cyclone Report for Hurricane Isabel (Beven and Cobb, 2004).

Isabel caused 83 million dollars of damage in Newport News, knocked down over 44,000 trees and cut nearly 99 percent of the City's power. Most of the $83 million damage was residential and business losses in Newport News. The damage assessment report showed a significant amount of dollars used for debris clearance/removal to restore usage to roads, water facilities, and public buildings.

5.2.3 Tornados – City of Newport News

The City of Newport News has experienced seven tornados over the period of 1951 to 2001(Table 5.2.3), which have caused a variety of damage. The most significant tornado occurred on September 5, 1979, which generated high winds and caused some injuries in the affected area, which included neighboring areas.

A tornado struck Newport News a little past 3 p.m. on August 6, 1993. A man on the James River Bridge saw three funnel clouds over the river. Two dissipated and the third touched down moving through the woods on the Newport News side of the river. The tornado tracked 12 miles through Newport News, Hampton and Langley Air Force Base. In Newport News, eight people were injured, 163 homes were damaged, 12 were condemned and damage costs were $1.2 million.

Table 5.2.3- Historic Tornados – City of Newport News

Date	Magnitude	Deaths	Injuries	Descriptions
June 27, 1951	F1	0	0	▪ None Reported
April 6, 1958	F1	0	0	▪ None Reported
October 7, 1965	F0	0	0	▪ None Reported
September 5, 1979	F3	0	2	▪ None Reported
June 1, 1982	F0	0	0	▪ None Reported
August 6, 1993	Not available	0	8	▪ $1.2 million
August 11, 2001	F0	0	0	▪ Weak tornado damaging a couple of mobile homes and produced minor damage at a townhouse complex near Fort Eustis

5.2.4 Wildfire – City of Newport News

Many wildfires are caused by human acts, both intentional and unintentional. Wildfires are also started through natural occurrences, such as lightning strikes. Wildfire danger can vary greatly season to season and is often exacerbated by dry weather conditions. Because of wild fire risk, VDOF has provided new information on identifying high-risk fire areas. Their Fire Risk Assessment Map was designed to help communities determine areas with the greatest vulnerability to wildfire.

The Wildfire Risk Assessment Map in Appendix B, delineates the aerial extent of wildfire vulnerability within the City of Newport News, based on VDOF fire risk assessment data. The large format Multi-Hazard Map provided with this plan also delineates wildfire hazard areas for Newport News, specifically. Approximately 9 percent of the City falls in a high wildfire risk area. Parameters used to establish these risk boundaries are land use, population density, slope, land cover and proximity to roads.

The proximity of the tree lines or brush to the highway or roadway is also included in the wildfire risk analysis to capture the human/wildfire causal relationship. Travel corridors increase the probability of human presence across a landscape, thereby increasing the probability of wildfire ignition. As such, areas closer to roads are much more likely to attain a higher ignition probability.

5.2.5 Vulnerability Assessment – City of Newport News

The PHMPC conducted a vulnerability analysis for each natural hazard that was identified as critical with medium to high hazard potential. As several of these hazards are prone to occur in any part of the City, the exposure associated with tornados and winter storms is assumed to include the entire city. This section describes the methodology used to perform the vulnerability analysis for each hazard and then lists the results of this analysis.

Flooding – City of Newport News

The City of Newport News GIS Department provided tax parcel data including the tax assessor database and digital copies of the FEMA delineated floodplains for the City. The 100-year flood hazard boundaries delineated on the existing FEMA FIRM for the City include detailed, approximate and V-zones. These shapefiles were merged into a single 100-year flood hazard layer and intersected with the parcel layer provided by the City. Any tax parcel that intersected the delineated floodplain was considered as inside the floodplain and its building improvement value was added to the total property value in the 100-year floodplain.

The dataset provided by the City contained 53,585 parcels. Approximately 4,596 (9 percent) of these parcels intersect the 100-year flood hazard area. The total at risk value associated with these parcels is $2,586,130,866. This is approximately 27 percent of the total improvement value for the entire city.

FEMA has developed a concept to highlight the impact that repetitively flooded structures have had on the NFIP. The term “repetitive loss,” as applied to the NFIP, refers to any property for which two or more flood insurance claims in excess of $1,000 each in a 10-year period of time have been paid. In 1998, FEMA reported that the NFIP's 75,000 repetitive loss properties had already cost $2.8 billion in flood insurance payments and numerous other flood prone properties continue to remain at high risk in the nation's floodplains. While these properties make up only one to two percent of the flood insurance policies currently in force, they account for 40 percent of the country's flood insurance claim payments. A report on repetitive loss structures completed by the National Wildlife Federation found that 20 percent of these structures are listed as being outside of the 100-year floodplain (Conrad et al. 1998).

Including flood insurance claims paid as a result of flood damage caused by Hurricane Isabel in 2003, FEMA has identified 20 structures as repetitive loss structures in the City of Newport News.

Hurricane – City of Newport News

Hazards U.S. – Multi Hazard (HAZUS®*MH*) was utilized to perform a wind hazard analysis for Newport News. HAZUS®*MH* software is a multi-hazard loss estimation program that was developed under a cooperative agreement between the National Institute of Building Sciences and FEMA. The current version of HAZUS®*MH* has the ability to calculate earthquake, wind, and flood hazards as well as potential economic losses associated with these hazards. The software is designed with the flexibility to perform loss estimations at three different levels. Level 1 utilizes all default parameters built into the software. Levels 2 and 3 require user defined scenarios and building inventory data. For the purpose of this plan, a Level 1 wind analysis was performed to calculate the wind hazard for each Peninsula community. The software package also has the ability to analyze historic storm data or a probabilistic scenario. The probabilistic scenario activates a database of many thousands of storm tracks and intensities. This scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year.

Table 5.2.5a lists the total dollar value of exposed structures for the City of Newport News. The HAZUS®*MH* software is based on the 2002 Census data. Although current development trends in the Peninsula region may render the 2002 Census data somewhat obsolete, this analysis depicts the probability of occurrence and can generally be used to estimate potential damages due to high winds.

Table 5.2.5a- Value of Exposed Structures from HAZUS®*MH* – City of Newport News

Occupancy Type	Value of Exposed Structures ($1,000)
Residential	8,859,193
Non-Residential	1,679,920
Total	**10,539,113**

The probabilistic analysis generated with the HAZUS®*MH* software utilized the same building stock information listed above. The probabilistic scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year. The probabilistic method was used to generate loss estimations of storms with specific recurrence intervals: 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year. Since residential structures comprise a significantly large percentage of the occupancy classification, these data are presented in Table 5.2.5b below.

Table 5.2.5b-Summary of Probabilistic Analysis – Residential Structures – City of Newport News

Return Period	Residential Building Damage – Number of Buildings			
	Minor	Moderate	Severe	Destruction
10-year	72	7	0	0
20-year	719	96	18	0
50-year	5,112	958	171	11
100-year	6,078	1,519	270	49
200-year	15,780	7,151	1,407	602
500-year	16,231	12,985	5,012	3,315
1000-year	14,325	14,266	7,240	5,477

Tornado – City of Newport News

The facilities and building stock that were identified as exposed under hurricane hazards are also exposed to tornado hazards. Tornados are random natural events that strike with little warning but are associated with thunderstorms and hurricanes.

Wildfire – City of Newport News

The Wildfire Risk Assessment data, provided by VDOF, was utilized to estimate the wildfire risk for the City of Newport News. This data layer was intersected with the City's tax parcel mapping in order to estimate the value of at risk structures.

According to the VDOF Wildfire Risk Assessment mapping, approximately nine percent of the City is located within the high wildfire risk zone. There are 1,856 parcels that intersect with this high wildfire area, which results in an at risk building stock value of $1,388,486,700.

Critical Facilities Analysis – City of Newport News

In order to assess the vulnerability of a community to natural hazards, the PHMPC conducted an inventory of Newport News structures and critical facilities (Appendix E). Critical facilities are those facilities that warrant special attention in preparing for a disaster and/or facilities that are of vital importance to maintaining citizen life, health, and safety during and/or directly after a disaster event.

The inventory of critical facilities for the City of Newport News includes emergency response facilities such as police stations, fire departments, emergency medical service stations (EMS), public facilities including schools and local government buildings. The code and number provided in the table identify these facilities on the all-hazard mapping provided in Appendix F. Those facilities that are geographically located within an identified hazard zone are listed in Tables 5.2.5c, 5.2.5d, and 5.2.5e.

Table 5.2.5c- Critical Facilities in 100-Year Floodplain

Name	Code	Number_
Pump Station	PS	PS 014
Pump Station	PS	PS 030
Pump Station	PS	PS 031
Pump Station	PS	PS 037
Pump Station	PS	PS 044
Pump Station	PS	PS 049
Pump Station	PS	PS 053
Pump Station	PS	PS 089
Pump Station	PS	PS 087
Pump Station	PS	PS 096
Pump Station	PS	PS 097
Pump Station	PS	PS 123
Pump Station	PS	PS 135
Pump Station	PS	PS 143
Pump Station	PS	PS 145
Pump Station	PS	PS 161
Pump Station	PS	PS 163
Pump Station	PS	PS 056
Pump Station	PS	PS 068
Pump Station	PS	PS 072
Pump Station	PS	PS 078
Pump Station	PS	PS 079
Pump Station	PS	PS 002
Pump Station	PS	PS 008
Pump Station	PS	PS 013
Richard T. Yates Elem.	SC	26

Source: AMEC
Critical Facility Key Code, see Appendix E

Table 5.2.5d - Critical Facilities at Risk - Surge Zone Hurricane Category 4

Name	Code	Number
Calvary Sda School	SC	7
Parkview Christian Academy Day	SC	15
B. T. Washington Middle	SC	18
Dunbar-Erwin Elem.	SC	20
Huntington Middle	SC	23
John Marshall Elem.	SC	25
Richard T. Yates Elem.	SC	26
Pump Station	PS	PS 014
Pump Station	PS	PS 017
Pump Station	PS	PS 018
Pump Station	PS	PS 027
Pump Station	PS	PS 031
Pump Station	PS	PS 032

Name	Code	Number
Pump Station	PS	PS 033
Pump Station	PS	PS 034
Pump Station	PS	PS 037
Pump Station	PS	PS 038
Pump Station	PS	PS 039
Pump Station	PS	PS 049
Pump Station	PS	PS 051
Pump Station	PS	PS 053
Pump Station	PS	WWPFS
Pump Station	PS	WWPDV
East End Health Center	CL	11
Whittaker Hosp Medical Office	CL	12
Youth Campus Day Care	DC	20
Ding Dong Kindergarten	DC	21
Tic-Toc Kindergarten	DC	22
Quality Nursery & Garden Center	DC	23
Fire Warehouse	FR	3
Station 2	FR	10
Station 7	FR	11
Zion Baptist Convalescent	NH	3
Nursing Home	NH	12
Mdn Center	NH	13
Spratley Housing	NH	15
Pump Station	PS	PS 099
Pump Station	PS	PS 089
Pump Station	PS	PS 112
Pump Station	PS	PS 116
Pump Station	PS	PS 086
Pump Station	PS	PS 095
Pump Station	PS	PS 096
Pump Station	PS	PS 097
Pump Station	PS	PS 118
Pump Station	PS	PS 120
Pump Station	PS	PS 123
Pump Station	PS	PS 125
Pump Station	PS	PS 139
Pump Station	PS	PS 145
Pump Station	PS	PS 092
Pump Station	PS	PS 108
Pump Station	PS	PS 149
Pump Station	PS	PS 159
Pump Station	PS	PS 161
Pump Station	PS	PS 163
Pump Station	PS	PS 154
Pump Station	PS	PS 054

Name	Code	Number
Pump Station	PS	PS 056
Pump Station	PS	PS 057
Pump Station	PS	PS 060
Pump Station	PS	PS 063
Pump Station	PS	PS 066
Pump Station	PS	PS 067
Pump Station	PS	PS 068
Pump Station	PS	PS 071
Pump Station	PS	PS 072
Pump Station	PS	PS 074
Pump Station	PS	PS 075
Pump Station	PS	PS 077
Pump Station	PS	PS 078
Pump Station	PS	PS 080
Pump Station	PS	PS 001
Pump Station	PS	PS 002
Pump Station	PS	PS 003
Pump Station	PS	PS 005
Pump Station	PS	PS 006
Pump Station	PS	PS 007
Pump Station	PS	PS 008
Pump Station	PS	PS 013

Source: AMEC
Critical Facility Key Code, see Appendix E

Table 5.2.5e-Critical Facilities at Risk - High Wildfire Hazard Zone

Name	Code	Number
Pump Station	PS	PS 030
Pump Station	PS	PS 031
Station 5	FR	2
Station 4	FR	5
Fire Training Center	FR	15
Woodside Hospital	HO	6
Pump Station	PS	PS 117
Pump Station	PS	PS 139
Pump Station	PS	PS 152
Pump Station	PS	PS 165
Pump Station	PS	PS 057
Pump Station	PS	PS 069
Pump Station	PS	PS 075

Source: AMEC
Critical Facility Key Code, see Appendix E

5.2.6 Capability Assessment – City of Newport News

As an additional tool to assist with the examination of the hazards identified and to evaluate the community's ability to plan, develop, and implement hazard mitigation activities, the planning team developed a local capability assessment for the City of Newport News. This assessment is designed to highlight both the codified, regulatory tools available to the community to assist with natural hazard mitigation as well as other community assets that may help facilitate the planning and implementation of natural hazard mitigation over time. The following Capability Assessment Matrix was used as a basis for the City of Newport News' mitigation plan.

Table 5.2.6 - Capability Matrix – City of Newport News

	City of Newport News
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	Yes
-Effective Flood Insurance Rate Map Date	1-17-86
-Substantial Damage Language	Yes
-Certified Floodplain Manager	No
-Number of Floodprone Buildings	4,596
-Number of NFIP policies	1,741 (38%) as of 6/04
-Maintain Elevation Certificates	Yes
-Number of Repetitive Losses	20

	City of Newport News
CRS Rating	None
Stormwater Program	Yes
Building Code Version Full-time Building Official	VUSBC (IBC 2003) Yes
- Conduct "As-built" Inspections	Yes
- BCEGS Rating	3
Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes
-Storm Ready Certified	Yes
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	Yes, for Surry only
-Emergency Notification (R-911)	Yes
-other (e.g., cable override)	Yes, cable-override
GIS system	Yes
-Hazard Data	Yes
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	Yes
Property Owner Protection Projects	Yes
Critical Facilities Protected	Not fully
Natural Resources Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

Form of Governance

A Council-Manager form of government in which seven persons are elected to serve on City Council manages Newport News. Two members are elected from each of three districts, and the mayor is elected at-large. The City Manager is appointed by the City Council. The City Council also appoints the City Attorney and the City Clerk.

Guiding Community Documents

The City of Newport News has a range of guidance documents and plans for each of their departments. These include a comprehensive plan, a Flood Protection Plan, and emergency management plans. The City uses building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the municipality guides its' future is through policies laid out in the comprehensive plan, entitled *Framework for the Future*.

Framework for the Future (2000)
The Code of Virginia requires all cities and counties in the state to have a comprehensive plan and to review it every five years to determine if revisions are necessary. The City of Newport News' *Framework for the Future* features the following:

- The plan presents long-range intentions regarding the direction and nature of future development, assesses current conditions and incorporates citizen desires into long-range public policy.
- Comprised of twelve elements that focus on aspects of future development: economic development, land use, transportation, education, parks and recreation, housing, public safety, historic preservation, human services, culture, environment, and urban services.
- Environmental element concentrates on air quality, wetlands, floodplains, natural heritage areas, soils, and water quality.
- Plans for continued growth and development and urban design in designated growth/redevelopment areas, including:
    - Oyster Point/Port Warwick
    - Patrick Henry Mall area, south of the airport
    - Endview Plantation
    - Lee Hall Industrial Park

The *Framework for the Future* also contains a *Chesapeake Bay Technical Support Document* addendum which further discusses physical constraints to development in the city: protection of potable water supply; shoreline erosion control; public and private access to the waterfront; and redevelopment of intensely developed areas and other areas targeted for redevelopment.

Zoning & Development Standards

- Identifies existing federal and state regulations for wetland, floodplain, and RPA/RMA protection.
- The document outlines required standards for new development and redevelopment based on use and zoning designation.

The City of Newport News has exceeded the minimum requirements of the NFIP through adoption of their floodplain management ordinance. The floodplain is designated as an Overlay Zoning District in Zoning Ordinance, Article XXXI, Section 45, Division 2. The community has 20 repetitive losses through the NFIP, three of which were constructed after the community's flood hazard areas were mapped (post-FIRM). The City conducted a post-flood analysis after Hurricane Floyd and concluded that one foot of freeboard would be mandated for floodplain structures. The ordinance was amended to incorporate one foot of freeboard for structures, and two feet of freeboard above the BFE for storage of certain chemicals. The freeboard also applies to structures built in the Coastal High Hazard Area. The City's Building Permit application includes a notation regarding the map panel and zone designation, and a space for the Finished Floor Elevation.

A Site Plan Review Committee for new commercial and multi-family development projects is made up of representatives from Fire and Police Departments, Newport News Waterworks, Department of Public Works, Department of Economic Development, Planning, and Codes Compliance. The Engineering Department sends at least three representatives to deal with traffic, stormwater, and storm sewer issues. Emergency Management is not involved in the Site Plan Review Committee. The City has been considering the USACE's desire to be included in the early stages of site plan review.

Building Codes

The Commonwealth of Virginia is responsible for enacting the Virginia Uniform Statewide Building Code (VUSBC), and the City of Newport News is responsible for enforcing the code locally. As of January of 2005, the VUSBC is based on the 2000 International Building Code, International Plumbing Code, International Mechanical Code, and International Fire Protection Code, and the 1999 National Electrical Code. The 2003 version of the IBC has been incorporated into the VUSBC, and went into effect in April 2005. The code contains the building regulations that must be complied with when constructing a new building or structure or an addition to an existing building, maintaining or repairing an existing building, or renovating or changing the use of a building or structure.

Enforcement of the VUSBC is the responsibility of the local government's building inspections department. Newport News charges fees to defray the costs of enforcement and appeals arising from the application of the code. The VUSBC contains enforcement procedures that must be used by the enforcing agency.

As provided in the Uniform Statewide Building Code Law, Chapter 6 (36-97 et seq.) of Title 36 of the Code of Virginia, the USBC supersedes the building codes and regulations of the counties, municipalities and other political subdivisions and state agencies, related to any construction, reconstruction, alterations, conversion, repair or use of buildings and installation of equipment therein. The USBC does not supersede zoning ordinances or other land use controls that do not affect the manner of construction or materials to be used in the construction, alteration, or repair.

Flood Protection Plan

The *Flood Protection Plan* was developed in 1999 as part of a review of stormwater management program elements in order to receive Flood Mitigation Assistance funding and as a future NFIP Community Rating System program element. The plan details the City's floodplain management activities, including (re)development regulations, capital projects, maintenance and education/outreach. New initiatives from the plan included development of flood reduction strategies for the Salter's Creek and Newmarket Creek floodplains.

Stormwater Program and Fees

In 1993, the City implemented a Stormwater Management Service Charge to fund a comprehensive stormwater management program, including capital project funding. Consequently, stormwater management capital project funding does not compete with other project funding such as that for schools and public buildings. Within the Salter's Creek and Newmarket Creek drainage basins, a *Master Drainage and Flood Control Plan* identified major capital projects to address flooding associated with the conveyance system. Implementation of these projects is ongoing and continues as funding becomes available.

Maintenance of the City's stormwater conveyance system is a priority element of the Comprehensive Stormwater Management Program and Flood Protection Plan. Major outfall ditches are on regular maintenance intervals generated by an automated work order system. Roadside, back and side lot ditch maintenance is done on a manual, preventive maintenance schedule.

Stormwater program employees are available to assist property owners with shoreline erosion problems. The engineers can conduct on-site inspections and provide recommendations, and may also act as a liaison with the State's Shoreline Erosion Advisory Service. The City's Department of Planning and Department of Development distributes a brochure on shoreline erosion that includes recommended measures and examples of poor shoreline management.

Public Education

Among the readily available public outreach mechanisms for the City of Newport News, the City's website (http://www2.ci.newport-news.va.us/newport-news/index.htm) provides residents with pertinent information, provides on-line complaint forms, real estate information site, and answers numerous Frequently Asked Questions (FAQs). The City also posts most of its guiding documents, including the Comprehensive Plan on this site.

The City has implemented a program to educate citizens about floodplain management issues. Direct mailings, community meetings and newspaper advertisements are used to inform citizens about the NFIP and the Flood Assistance Program (see below). The City has also provided at least two of its five libraries with references on floodplain management and flood insurance.

Public educational advisories, public forums and brochure distribution addressing preparedness issues are conducted on an ongoing basis. The City uses presentations at booths, fairs, special needs meetings, and neighborhood group meetings to promote family preparedness and public awareness of shelter locations and evacuation routes.

Emergency Preparedness

Emergency Alert System (EAS) is a national civil emergency alert system that uses message relays between member radio and television stations to inform the public about immediate threats to national security, life, and property. EAS is now routinely used for severe weather warnings and can also be employed to disseminate Amber Alerts for missing children. The enhancement is an initiative of Governor Warner's Secure Virginia Panel designed to improve statewide preparedness, response, and recovery capabilities for emergencies and disasters. Governor Mark R. Warner announced on June 5, 2004, that Virginia would enhance its public warning capabilities with a new satellite-based system that can rapidly transmit EAS messages throughout the Commonwealth. Newport News is adding a radio station that will broadcast Newport News information only.

Storm Ready – Newport News was one of the first five communities in Virginia to be "Storm Ready." Storm Ready is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle severe weather. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations. To be officially Storm Ready, a community must:

- Establish a 24-hour warning point and emergency operations center,
- Have more than one way to receive severe weather warnings and forecasts and to alert the public,
- Create a system that monitors weather conditions locally,
- Promote the importance of public readiness through community seminars, and
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

Newport News uses Dialogic to manage the City's database of special needs residents. The program allows emergency managers to contact these residents directly in the event of an emergency. A special disaster hotline is activated during disasters, and all residents can call 269-2910 for assistance during events. The Office of Emergency Management has set up a special volunteer Emergency Information Team to supplement regular emergency management staff during disaster events.

Following Hurricanes Isabel and Floyd, the City made special arrangements with nursing homes, other special needs facilities, and Dominion Power to facilitate priority power restoration at these structures. A special needs shelter was established during Hurricane Isabel. In addition, the City Jail and Riverside Hospital have emergency power generators. Riverside Hospital has instituted new security procedures to prevent use of hospital power by area residents who needed to charge cell phones and conduct other non-emergency business after Hurricane Isabel.

Other Mitigation Activities

Flood Assistance Program (FAP) – FAP is a voluntary program that offers flood assistance to owners of structures that are located in the 100-year floodplain, that have finished flood elevations below the BFE and for which construction began prior to December 31, 1974 (pre-FIRM), regardless of the owner's insurance status. There are three types of assistance considered by the program: structure and property acquisition; structure elevation; and structure relocation. Based on a cost-benefit analysis, the City determines which assistance alternative is the most appropriate for each individual site. The program is administered and funded through the City's Department of Engineering, and administrative guidelines for the assistance are in place. As of January 2005, the City has purchased approximately 30 structures and/or parcels through FAP and dedicated the newly acquired land to open space use in perpetuity. The program began in response to flooding associated with Hurricane Floyd. The City has independently completed first floor elevation surveys of all structures in the Salter's Creek and

Newmarket Creek floodplains, and the FAP efforts have been focused in these areas due to chronic flooding. The City has also used some stormwater utility funds to purchase homes in these areas.

In November of 1969, the USACE in cooperation with the Cities of Newport News and Hampton completed a local flood control project on Newmarket Creek north of Mercury Boulevard. The project improved the Newmarket Creek channel from Dresden Drive to Mercury Boulevard, where a dam was constructed to divert floodwaters from Newmarket Creek into Government Ditch. In the 1980s, the City of Newport News extended the Newmarket Creek Improvement project north from Dresden Drive to J. Clyde Morris Boulevard. The City's channelization project confined the 100-year flood to the newly constructed channel cross-section. These projects significantly reduced the frequency of flooding between Mercury Boulevard and J. Clyde Morris Boulevard.

Green Foundation – The Newport News Green Foundation works with residents and landowners to preserve and establish green areas in the city. The program is administered through the Department of Development. Priority acquisitions include remnant parcels with trees, along major arterials. City planning officials note that this program assists with preservation of open space, and could be used as a mitigation tool to address future land use of flood-prone, acquired parcels.

Newport News has 170 sanitary sewer pumping stations throughout the city. Officials applied for post-Isabel mitigation funding to elevate six of the repetitively-flooded stations. Federal-funding was denied; however, the City has decided the project must go forward and has included it in the budget for the coming year.

The City's EOC was originally located in the basement of City Hall, in the eastern end of Newport News. Due to flooding concerns, a new EOC compound was constructed in the Oyster Point area. The windows of the new EOC are hurricane-proof (Category 2 storm), and the building complex has its own regularly-tested power generator back-up system. Following Hurricane Isabel and the receipt of updated storm surge mapping, several of the city emergency shelters have been taken off the list. The new list of primary and secondary shelters does not include any flood-prone structures, and the City is making arrangements to ensure that residents in the southeast community (flood-prone) part of the city are bused to shelters in the northern section. Primary shelters are built to resist Category 2 storms.

5.3 City of Williamsburg Profile

The following sections present a detailed assessment of critical hazards that affect the City of Williamsburg. Understanding these hazards will assist the Peninsula region in its process of identifying specific risks and developing a mitigation strategy to address those risks.

5.3.1 Flooding – City of Williamsburg

As part of the NFIP, FEMA has created a Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for the City of Williamsburg. In addition, the NCDC tracks the occurrence of flooding events for communities across the nation. These data sources and others were utilized in developing the hazard identification and vulnerability assessment.

The FIS for the City of Williamsburg was published March 2, 1994. The FIRMs, which accompany this FIS, delineate the 100- and 500-year flood hazard boundaries for flooding sources identified in areas of growing development or areas predicted to have future development, at the time of the report. A detailed study was conducted in order to delineate the 100- and 500-year flood hazard boundaries for the City. This analysis resulted in a 100-year stillwater elevation of 8.5 feet for most of the City. The significant flood events outlined in the FIS are given below in Table 5.3.1a, although specific reference to flooding or damage in Williamsburg in the FIS is scarce.

Table 5.3.1a -Significant Flood Events – City of Williamsburg

Date	Storm	Tide Elevations
August 1933	Hurricane	Max tide heights averaged 8 feet
April 1956	Nor'easter	Not given
October 1957	Hurricane – Not Named	Not given
September 1960	Hurricane Donna	Not given
March 1962	Nor'easter	Max tide heights averaged 6.8 feet

Source: FEMA 1994

The NCDC, operated by NOAA, also keeps a record of significant weather related events and damage estimates for the entire country. Listed below (Table 5.3.1b) is the significant event that affected the City of Williamsburg.

Table 5.3.1b- NCDC Listed Significant Flood Event –City of Williamsburg

Date	Event	Precipitation	Comments
September 15 to 17, 1999	Hurricane Floyd	12 to 18 inches	▪ Road flooding and landslides

Community officials indicate that there have been two additional and significant flood events in Williamsburg that were not included in the FIS or the NCDC databases. In June 1963, excessively heavy rains caused the original Waller Mill Dam to break, damaging homes and infrastructure in Williamsburg. The 270-foot dam was rebuilt, and currently retains a 343-acre reservoir. The second flood event occurred on August 18, 1989 when a remarkable rain cell unloaded 12 inches of precipitation on the City, flooding City Hall.

5.3.2 Hurricanes – City of Williamsburg

The FIS for the City of Williamsburg identified three historic hurricanes that affected the City (see Table 5.3.1a above); however, specific damage details are not provided. The NCDC dataset listed seven hurricanes for the City of Williamsburg for the period 1950 to June 2004. These storms are listed in Table 5.3.2. An obvious disconnect between the data sources is evident. The NCDC database covers the past 50 years, but only cites storms since 1995 and omits major hurricanes, such as Donna (1960), which are cited in the FIS.

Hurricane Floyd moved through the area dropping several inches of rain within 24 hours and generating winds in excess of 40 mph. Lower James City County reported 12.83 total inches of rain for the storm. In Williamsburg, the primary damage was from road flooding and landslides.

Hurricane Isabel made landfall on September 18, 2003 as a Category 2 hurricane near Drum Inlet, North Carolina. Hurricane Isabel is considered to be one of the most significant tropical cyclones to hit this area since Hurricane Hazel (1954) and the Chesapeake-Potomac hurricane of 1933 (Hazel is not included on either the NCDC or FIS data sets, but has been identified locally by the PHMPC). Isabel produced storm surges six to eight feet above normal high tide levels and is directly responsible for 10 deaths in Virginia and indirectly responsible for 22 deaths. Isabel caused wide spread wind and storm surge damage in eastern North Carolina and southeastern Virginia, currently estimated at $925 million in Virginia. All of the above data was taken from the NOAA Tropical Cyclone Report for Hurricane Isabel (Beven and Cobb, 2004).

During the 2004 hurricane season, five separate tropical cyclones (Charley, Frances, Ivan, Jeanne, and Gaston) of varying magnitude hit the eastern and Gulf coasts of the United States. Although the damage from these storms to the Peninsula region was minor, the occurrence of significant multiple events over a few weeks highlights the vulnerability of the planning area to these storms, and infers the disruption that they create (Table 5.3.2).

Table 5.3.2- Historic Hurricanes – City of Williamsburg

Date	Storm Name	Category	Descriptions
August 15, 1995	Felix	Not given	▪ No major damage reported in VA ▪ Tides 2.0-2.5 feet above normal
July 12, 1996	Hurricane	Not Given	▪ None given
September 1, 1999	Dennis	Hurricane/Tropical Storm	▪ Prolonged period of tropical cyclone ▪ Generated a F2 tornado ▪ Tide 3 feet above normal ▪ Coastal flooding ▪ 2 to 5 inches of rain ▪ $27,000 damage
September 15, 1999	Hurricane Floyd	Category 1	▪ Spawned 2 tornados ▪ Hundreds of downed tress ▪ Tide 3.9 feet above normal ▪ Numerous roads washed out ▪ $99.4 million in property damage over the entire affected area
September 18, 2003	Hurricane Isabel	Category 1/Tropical Storm	▪ Hundreds of downed tress ▪ Loss of power ▪ Damaged residents and businesses ▪ Greatest storm surge since Hazel
August 18, 2004	Charley	Hurricane	▪ Highest sustained wind was 73 mph ▪ Uprooted of trees and downed numerous power lines ▪ Over 2 million Virginians without power ▪ Heavy rain and wind gust
September 8, 2004	Frances	Hurricane	▪ Generated 9 tornados in Central Virginia ▪ High winds ▪ Large amounts of rainfall/flooding
September 17, 2004	Ivan	Hurricane	▪ Spawned unconfirmed tornados ▪ Power outage (66,000) ▪ Heavy rain/flooding
September 28, 2004	Jeanne	Hurricane	▪ Flash flooding/heavy rainfall ▪ Power outage
August 30, 2004	Gaston	Tropical Depression	▪ Hard rains that processed flooding ▪ Roads under water ▪ Power outage (99,600 statewide)

5.3.3 Tornados – City of Williamsburg

The City of Williamsburg has experienced three recorded tornados between 1896 to 1999 (Table 5.3.3) that caused damage. The most significant tornado occurred on October 14, 1986, which generated wind of 110 mph and caused $1.8 million in damages the entire affected area.

Table 5.3.3- Historic Tornados – City of Williamsburg

Date	Magnitude	Deaths	Injuries	Descriptions
July 8, 1896	Not Given	Not Given	2-5	▪ Spawned by a hurricane ▪ Barns and small houses destroyed
May 8, 1984	Not Given	Not Given	Not Given	▪ Spawned by sever thunderstorms ▪ Destroyed three mobile homes
October 14, 1986	F2	Not Given	Not Given	▪ Downburst of 110mph ▪ Damages of $1.8 million over entire affected area

5.3.4 Wildfire – City of Williamsburg

Many wildfires are caused by human acts, either intentional, such as arson or unintentionally. They can also be started by natural occurrences, such as lightning strikes. Wildfire danger can vary greatly from season to season and is often exacerbated by dry weather conditions. Because of wildfire risk, VDOF has produced Fire Risk Assessment Maps designed to help communities determine areas with the greatest vulnerability to wildfire.

The Wildfire Risk Assessment Map, Appendix B, delineates the aerial extent of wildfire vulnerability within the City of Williamsburg. Approximately 55 percent of the city is in a high wildfire risk area. Parameters used to establish these risk boundaries are land use, population density, slope, land cover and proximity to roads. The proximity of the tree lines or brush to the highway or roadway is also included in the wildfire risk analysis to capture the human/wildfire causal relationship. Travel corridors increase the probability of human presence, thereby increasing the probability of wildfire ignition. Thus, areas closer to roads are much more likely to attain a higher ignition probability.

Parts of the Peninsula region near Williamsburg are experiencing an accelerated development rate. Land that once was rural and relatively inaccessible is now either under development or planned for development. Although the clearing of land for development removes potential fuel sources for wildfire, the wildfire hazard is not necessarily diminished because human access to the area is significantly increased. This development trend expands the wildland/urban interface, by placing structures in close proximity to large amounts of vegetation, which in turn increases the risk of wildfire (NWUIFPP undated).

5.3.5 Vulnerability Assessment – City of Williamsburg

The PHMPC conducted a vulnerability analysis for each critical hazard that was identified as having a medium to high hazard potential of occurrence. As several of these hazards are prone to occur in any part of the city, the exposure associated with tornados and winter storms is assumed to include the entire city. This section describes the method used to perform the vulnerability analysis for each hazard and then lists the results.

Flooding – City of Williamsburg
The City's GIS consultant provided a building layer, which was overlaid with the City of Williamsburg FIRM. The two maps were compared to determine the number of buildings in the 100-year floodplain, as the results determined that no buildings were located within the 100-year floodplain of Williamsburg.

FEMA has developed a concept to highlight the impact that repetitively flooded structures have had on the NFIP. The term "repetitive loss," as applied to the NFIP, refers to any property for which two or more flood insurance claims in excess of $1,000 each in a 10-year period of time have been paid. Including flood insurance claims paid as a result of flood damage caused by Hurricane Isabel in 2003, FEMA has identified no (zero) repetitive loss structures in the City of Williamsburg.

Hurricane – City of Williamsburg

Hazards U.S. – Multi Hazard (HAZUS$^{®MH}$) was utilized to perform a wind hazard analysis for the entire Peninsula region. HAZUS$^{®MH}$ software is a multi-hazard loss estimation program that was developed under a cooperative agreement between the National Institute of Building Sciences and FEMA. The current version of HAZUS$^{®MH}$ has the ability to calculate earthquake, wind, and flood hazards as well as potential economic losses associated with these hazards. The software is designed with the flexibility to perform loss estimations at three different levels. Level 1 utilizes all default parameters built into the software. Levels 2 and 3 require user defined scenarios and building inventory data. For the purpose of this Plan, a Level 1 wind analysis was performed to calculate the wind hazard for each Peninsula community. The probabilistic scenario activates a database of many thousands of storm tracks and intensities. This scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year.

Table 5.3.5a lists the total dollar value of exposed structures for the City of Williamsburg to wind damage based on the 2002 Census data.

Table 5.3.5a- Value of Exposed Structures from HAZUS$^{®MH}$ – City of Williamsburg

Occupancy Type	Value of Exposed Structures ($1,000)
Residential	727,908
Non-Residential	229,073
Total	**956,981**

The probabilistic analysis generated with the HAZUS$^{®MH}$ software utilized the same building stock information listed above for the 1933 historic hurricane. The probabilistic scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year. The probabilistic method was used to generate loss estimations of storms with specific recurrence intervals: 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year. Since residential structures comprised a significantly large percentage of the occupancy classification these data are presented in Table 5.3.5b below.

Table 5.3.5b- Summary of Hurricane Probabilistic Analysis on Residential Structures – Williamsburg

Return Period	Residential Building Damage – Number of Buildings			
	Minor	Moderate	Severe	Destruction
10-year	5	0	0	0
20-year	21	1	0	0
50-year	106	9	1	0
100-year	17	1	0	0
200-year	719	255	14	5
500-year	922	712	98	46
1000-year	897	822	148	69

Tornado – City of Williamsburg
The facilities and building stock that were identified as exposed under hurricane hazards are also exposed to tornado hazards. Tornados are random natural events that strike with little warning but are associated with thunderstorms and hurricanes. No damage estimates have been created for tornados that might strike Williamsburg.

Wildfire – City of Williamsburg
The Wildfire Risk Assessment data, provided by the Virginia Department of Forestry, was used as a starting point to estimate the wildfire risk for the City of Williamsburg. This data layer was revised by City staff and incorporated into the all-hazard map (Appendix F). This data layer was overlaid with the City's tax parcel mapping in order to estimate the value of at risk structures. The VDOF also provided the number of wildfire incidence reported from 1995-2001.

According to the VDOF, no wildfires were reported in Williamsburg between 1995-2001. City staff provided the value of residential and commercial parcels that are at risk to wildfire. The values are based on the improvement values for residential and commercial parcels that intersect the high wildfire hazard areas. The analysis resulted in an at-risk value of $14,582,700 for residential properties and $9,304,700 for commercial properties.

Critical Facilities
The PHMPC also conducted an inventory of Williamsburg critical facilities (Appendix E). Critical facilities are those facilities that warrant special attention in preparing for a disaster and/or facilities that are of vital importance to maintaining citizen life, health, and safety during and/or directly after a disaster event. The inventory of critical facilities for the City of Williamsburg includes emergency response facilities such as police stations, fire departments, emergency medical service stations (EMS), public facilities including schools and local

government buildings (Table 5.3.5c). Those critical facilities that are geographically located within an identified hazard zone are listed below.

Table 5.3.5c-Critical Facilities at Risk – High Wildfire Hazard Zone

Name	Code	Number
Pump Station	PS	534
Pump Station	PS	536
Pump Station	PS	532

Source: AMEC
Critical Facility Key Code, see Appendix E

5.3.6 Capability Assessment – City of Williamsburg

As an additional tool to assist with the examination of the hazards identified and to evaluate the community's ability to plan, develop, and implement hazard mitigation activities, the planning team developed a local capability assessment for the City of Williamsburg. This assessment is designed to highlight both the codified, regulatory tools available to the community to assist with natural hazard mitigation as well as other community assets that may help facilitate the planning and implementation of natural hazard mitigation over time. The following Capability Assessment Matrix was used as a basis for the City of Williamsburg's mitigation plan.

Table 5.3.6 - Capability Matrix – City of Williamsburg

	City of Williamsburg
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	No – using Chesapeake Bay Preservation ordinance
-Effective Flood Insurance Rate Map Date	3-2-94
-Substantial Damage Language	No
-Certified Floodplain Manager	No
-Number of Floodprone Buildings	0
-Number of NFIP policies	29, as of 12/03
-Maintain Elevation Certificates	No
-Number of Repetitive Losses	0
CRS Rating	None
Stormwater Program	Yes
Building Code Version Full-time Building Official	VUSBC (IBC 2003) Yes
- Conduct "As-built" Inspections	Yes
- BCEGS Rating	2

	City of Williamsburg
Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes
-Storm Ready Certified	No
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	Yes, just for Surry
-Emergency Notification (R-911)	No
-other (e.g., cable override)	Text alerts in public bldgs (w/James City County)
GIS system	under development
-Hazard Data	under development
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	under development
Structural Protection Projects	Yes
Property Owner Protection Projects	Yes
Critical Facilities Protected	Not fully
Natural Resources Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

One highlight from the matrix is the existence of 29 NFIP policies, when there are no buildings within the 100-year floodplain. This suggests the City may be unaware of flooding or drainage issues.

Form of Governance

The Williamsburg City Council is composed of five members, elected at-large. The Council appoints the Mayor, Vice Mayor, City Manager, City Attorney and Clerk of Council. The Mayor chairs the City Council and acts as the official head of the City government. The City Manager administers the City government, carrying out the policies of City Council. The Council members serve four-year staggered terms, with elections held in May in even-numbered years.

Guiding Community Documents

The City of Williamsburg has a range of guidance documents and plans for each of their departments. These include a comprehensive plan and emergency management plans. The City uses building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the municipality guides its future is through policies laid out in the Comprehensive Plan.

Comprehensive Plan

The Code of Virginia requires all cities and counties in the state to have a comprehensive plan and to review it every five years to determine if it needs to be revised. The *1998 Comprehensive Plan* is the City's fifth plan, and will be updated in 2005. Although the *1953 Comprehensive Plan* was the first formal plan adopted under State law, the City's first plan in 1633 encouraged a new settlement at Middle Plantation with high ground, better drainage, good water and more central to the growing colony, out of the range of a ship's guns and less vulnerable to mosquitoes. The modern-day document features the following:

- The plan presents long-range intentions regarding the direction and nature of future development.
- Plan goals are grouped into seven general categories: environment, transportation, housing, land use, public services, economic development and implementation.
- Geographically, the plan is divided into 10 planning areas: Capitol Landing, Center City, Colonial Williamsburg, Courthouse, Midtown, Patriot, Richmond Road, Strawberry Plains, Wales, and the Entrance Corridors.
- The Open Space and Recreation element focuses on planned improvements to both active and passive parks at Capitol Landing, College Creek, Papermill Creek, Merrimac Trail, Quarterpath Park, Berkeley Park, and Waller Mill Park.
- Plans for continued growth and development and urban design in designated growth/redevelopment areas, including:
    - Riverside Hospital property holdings
    - High Street
- Plans for necessary transportation enhancements and improvements to service projected growth.

As a result of recommendations in the *1989 Comprehensive Plan*, a Listing of Significant Architecture and Areas in Williamsburg was created. The database is based on the results of a 1992 Architectural Survey. An Architectural Review Board (ARB) reviews development proposals for listed properties or properties in the vicinity of the Architectural Preservation District and Corridor Protection Districts. Design Review Guidelines transcribe the design review and community preservation goals used by the ARB. The latest Comprehensive Plan designates 301 acres as "museum support", or areas that are part of Colonial Williamsburg or the historic campus of the College of William and Mary. Colonial Williamsburg maintains a database with 88 of the historic structures within their preview.

Zoning & Development Standards

- Identifies existing federal and state regulations for wetland and RPA/RMA protection.
- The document outlines required standards for new development and redevelopment based on use and zoning designation.

FEMA Region III has determined that the City of Williamsburg has adopted the minimum requirements of the NFIP through adoption of their Chesapeake Bay Preservation Ordinance at Article VIII of the Zoning Ordinance. Williamsburg has adopted stringent RPA and RMA zones with 100 feet and 500 feet buffers, respectively. The ordinance does not address new structural requirements (e.g., lowest floor elevation) and exempts remodeling or alterations to nonconforming principal structures, public utilities, railroads and other infrastructure, including water wells.

The FIRM indicates limited non-tidal floodplains exist along College Creek, Papermill Creek, Tutter's Neck Pond, and Queen Creek. The City's plan review, land disturbance and building permit applications do not contain any reference to flood hazards; however, the *Site Plan Checklist* mandates delineation of floodplain limits on the site plans.

A Technical Review Committee for new development is made up of representatives from Codes Compliance, Fire, Police, Public Works, and Planning.

Stormwater Program

Oversight for the City's drainage system is provided by the Department of Public Works, Engineering Division. Engineering staff review site and subdivision plans to ensure compliance with the City's ordinances, provide project management for the City's capital improvement program, and provide quality control on construction of public improvements. Site plans for large developments are required to incorporate a stormwater fee or stormwater utility to ensure long-term maintenance of the drainage improvements. The Department has assisted with installation of BMPs for several chronically-flooded intersections. Engineers are also available to assist citizens with questions on all aspects of Public Works and Utilities.

Public Education

Among the readily available public outreach mechanisms for the City of Williamsburg, the City's website (http://www.ci.williamsburg.va.us/index.htm) provides residents with pertinent information, a property information tool, and answers to numerous Frequently Asked Questions. The City also posts most of its guiding documents, including the Comprehensive Plan.

The Fire and Police Departments conduct numerous types of public outreach regarding crime and fire prevention, including a program for fourth-grade students regarding fire and all-hazard safety. The Emergency Preparedness web site contains sections promoting family disaster preparedness, and a Neighborhood Guide with action plans and other valuable information for Williamsburg's residents and visitors. City Hall maintains a display of pertinent brochures and disaster-related handouts.

Emergency Preparedness

Emergency Alert System (EAS) is a national civil emergency alert system that uses message relays between member radio and television stations to inform the public about immediate threats to national security, life, and property. EAS is now routinely used for severe weather warnings and can also be employed to disseminate Amber Alerts for missing children. The enhancement is an initiative of Governor Warner's Secure Virginia Panel designed to improve statewide preparedness, response, and recovery capabilities for emergencies and disasters. Governor Mark R. Warner announced June 5, 2004, that Virginia will enhance its public warning capabilities with a new satellite-based system that can rapidly transmit EAS messages throughout the Commonwealth. WMBG 740AM provides public notifications for Williamsburg.

Community Emergency Response Teams – By summer 2006, the City plans to recruit, train, and deploy functioning Neighborhood Response Teams, trained through the Citizen Corps/CERT process, to assist with government response of natural and manmade disasters and emergencies. CERT helps communities respond to disasters during the first 72 hours following a disaster when flooded roads, disrupted communications, and emergency demand outweigh local emergency services. The purpose of CERT training is to provide private citizens with basic skills to handle virtually all of their own needs and then to respond to their community's needs in the aftermath of a disaster.

Other Mitigation Activities

Numerous best management practices (BMPs) have been implemented to alleviate chronic flooding in key intersections, including a redesigned drainage system along Richmond Road with larger culverts, and improved drainage at the Yankee Candle Factory. A dam break in 1988 resulted in a pond redesign within the City. Several private property owners have addressed problems with erosion control and mudslides on steep slopes, especially following the heavy precipitation associated with Hurricane Floyd.

Critical facility protection has been addressed through a Homeland Security Assessment, which notes the importance of Williamsburg as home to the "ideas of democracy." Electronic card access for the EOC was added to increase security during disasters and terror alerts. The reservoir and pump station were recently fenced. A mobile command unit for the EOC has been arranged to provide backup in the case of an event in central Williamsburg. The City's Property Information System is now backed up and maintained by a remote vendor with power backup. During and after Hurricane Isabel when power was unavailable, City officials had no access to the system because the remote vendor did not have power. The City also maintains a database of critical road intersections and has developed a plan to provide power backup to those intersections as necessary. The City's filter plant now has power backup and all pump stations will soon have generator back-up. During power outages, volunteer Ham radio operators are invited to the EOC to assist with communications.

Many special needs residents are addressed in State-mandated emergency plans for nursing homes. Backup power plans are incorporated into the plans, and emergency management officials meet quarterly with hospital and nursing home representatives to address planning issues. Williamsburg has added hospital and nursing home representatives to the EOC.

In cooperation with James City County, Williamsburg is installing text alerts for severe weather in public buildings, including school and libraries. Large digital readout boxes are installed, generally above prominent doorways, and can be programmed to display a particular warning or message. Rather than sharing shelters with James City County as in previous disasters; Williamsburg is developing a new shelter plan for their residents.

5.4 James City County Profile

The following sections present a detailed assessment of critical hazards that affect James City County. Understanding these hazards will assist the Peninsula region in its process of identifying specific risks and developing a mitigation strategy to address those risks.

5.4.1 Flooding – James City County

Due to its geographic location, James City County is susceptible to tidal and non-tidal flooding. Storms associated with coastal flooding include tropical cyclones and nor'easters. These types of events typically drop large amounts of rain and generate high winds that result in storm surge and non-tidal flow resulting from upstream precipitation. Storm surge is the water that is pushed toward the shore by the persistent force of the winds of an approaching storm. Astronomical tides occur independent of climactic conditions. Depending on the tide level at the time a land-falling storm surge may be elevated. Flash flooding and urban flooding are also a concern within the County limits.

As part of the NFIP, FEMA has created a Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for James City County. In addition, the NCDC tracks the occurrence of flooding events for communities across the nation. All of these data sources were utilized in developing the hazard identification and vulnerability assessment.

FEMA published a FIS for James City County, dated February 6, 1991. The FIRMs, which accompany this FIS, delineate the 100- and 500-year flood hazard boundaries for flooding sources identified in areas of growing development or areas predicted to have future development, at the time of the report. A detailed wave height analysis was developed in order to delineate the 100- and 500 year flood hazard boundaries for the County. This analysis resulted in a 100-year stillwater elevation of 8.5 feet for the County and a maximum 100-year wave crest of 11 to 13 feet. Refer to this report for a detailed description of methods and assumptions. The significant flood events outlined in the FIS are given below in Table 5.4.1a.

Table 5.4.1a- Significant Flood Events – James City County

Date	Storm	Tide Elevations
August 1933	Hurricane	Max tide heights averaged 8 feet
April 1956	Nor'easter	Not given
October 1957	Hurricane – Not Named	Not given
September 1960	Hurricane Donna	Not given
March 1962	Nor'easter	Max tide heights averaged 6.8 feet

Source: FEMA 1991

The NCDC, operated by NOAA, keeps a record of significant weather related events and damage estimates for the entire country. Listed below (Table 5.4.1b) are the significant events that have affected James City County.

Table 5.4.1b- NCDC Listed Significant Flood Events –James City County

Date	Event	Precipitation	Comments
September 15 to 17, 1999	Hurricane Floyd	12 to 18 inches	▪ Numerous roads washed out due to flooding ▪ Flooding considered 500-year flood ▪ Enormous crop damage
July 19, 2000	Flash Flood	Not given	▪ Heavy rain caused flooding and road closures of Routes 30 and 60 near Toano

5.4.2 Hurricanes – James City County

The FIS for James City County identified three hurricanes and 2 nor'easters that affected the County (see Table 5.4.1a above); however, specific damage estimates were not given. The NCDC dataset listed five hurricanes for James City County for the period between 1950 to June 2004. These storms are listed in Table 5.4.2. As in all other Peninsula communities, there are clear gaps and overlaps in the available data.

Hurricane Floyd moved through the area dropping four to five inches of rain within 24 hours and generated winds in excess of 40 mph. Throughout the Peninsula, trees and power lines were knocked down and roads were flooded; over 5,500 homes were left without power.

Hurricane Isabel tree damage in James City County

Hurricane Isabel made landfall on September 18, 2003 as a Category 2 hurricane near Drum Inlet, North Carolina. Hurricane Isabel is considered to be one of the most significant tropical cyclones to hit this area since hurricane Hazel (1954) and the Chesapeake-Potomac Hurricane of 1933. Isabel produced storm surges 6 to 8 feet above normal high tide levels and is directly responsible for 10 deaths in Virginia and indirectly responsible for 22 deaths. Isabel caused widespread wind and storm surge damage in eastern North Carolina and southeastern Virginia, currently estimated at $925 million in Virginia. All of the above data was taken from the NOAA Tropical Cyclone Report for Hurricane Isabel (Beven and Cobb, 2004).

Table 5.4.2- Historic Hurricanes – James City County

Date	Storm Name	Category	Descriptions
August 15, 1995	Felix	Not given	▪ No major damage reported in VA ▪ Tides 2.0-2.5 feet above normal
July 12, 1996	Hurricane	Not Given	▪ None given
September 1, 1999	Dennis	Hurricane/Tropical Storm	▪ Prolonged period of tropical cyclone ▪ Highest sustained winds at Langley 52 mph ▪ Generated a F2 tornado ▪ Tide 3 feet above normal ▪ Coastal flooding ▪ 2 to 5 inches of rain ▪ $27,000 damage
September 15, 1999	Hurricane Floyd	Category 1	▪ Spawned 2 tornados ▪ Hundreds of downed tress ▪ Tide 3.9 feet above normal ▪ Numerous roads washed out ▪ $99.4 million in property damage over the entire affected area ▪ Dam failure near Scotland Ferry/Route 31- this led to houses being flooded
September 18, 2003	Hurricane Isabel	Category 1/Tropical storm	▪ Hundreds of downed tress ▪ Loss of power ▪ Damaged residents and businesses ▪ Greatest storm surge since Hazel
August 18, 2004	Charley	Hurricane	▪ Highest sustained wind was 73 mph ▪ Uprooted of trees and downed numerous power lines ▪ Over 2 million Virginians without power ▪ Heavy rain and wind gust
September 8, 2004	Frances	Hurricane	▪ Generated 9 tornados in Central Virginia ▪ High winds ▪ Large amounts of rainfall/flooding
September 17, 2004	Ivan	Hurricane	▪ Spawned unconfirmed tornados ▪ Power outage (66,000) ▪ Heavy rain/flooding
September 28, 2004	Jeanne	Hurricane	▪ Flash flooding/heavy rainfall ▪ Power outage
August 30, 2004	Gaston	Tropical Depression	▪ Hard rains that processed flooding ▪ Roads under water ▪ Power outage (99,600 statewide)

5.4.3 Tornados – James City County

James City County has experienced three tornados over the period of 1896 to 1999 (Table 5.4.3), which have caused a variety of damage. The most significant tornado occurred on October 14, 1986, which generated wind of 110 mph and cause $1.8 million in damages over the entire affected area.

Table 5.4.3-Historic Tornados – James City County

Date	Magnitude	Deaths	Injuries	Descriptions
July 8, 1896	Not Given	Not Given	2-5	▪ Spawned by a hurricane ▪ Barns and small houses destroy
May 8, 1984	Not Given	Not Given	Not Given	▪ Spawned by sever thunderstorms ▪ Destroyed three mobile homes
October 14, 1986	F2	Not Given	Not Given	▪ Downburst of 110mph ▪ Damages of $1.8 million over entire affected area

5.4.4 Wildfire – James City County

Wildfires are caused through human acts like arson or careless accidents, or through natural occurrences, such as lightning strikes. Wildfire danger can vary greatly season to season and is often exacerbated by dry weather conditions. Because of wildfire risk, VDOF has developed Fire Risk Assessment Maps designed to help communities determine areas with the greatest vulnerability.

The Wildfire Risk Assessment Map, Map C-3, delineates the aerial extent of wildfire vulnerability within James City County. Approximately 33 percent of the County lies within a high wildfire risk area. Parameters used to establish these risk boundaries are land use, population density, slope, land cover and proximity to roads. The proximity of the tree lines or brush to the highway or roadway is also included in the wildfire risk analysis to capture the human/wildfire causal relationship. Travel corridors increase the probability of human presence across a landscape, thereby increasing the probability of wildfire ignition. As such, areas closer to roads are much more likely to attain a higher ignition probability. James City County is currently experiencing an accelerated development rate. Land that once was rural and relatively inaccessible is now either under development or planned for development. Although the clearing of land for development removes potential fuel sources for wildfire, the wildfire hazard is not necessarily diminished because human access to the area is significantly increased. This development trend expands the wildland/urban interface, which place structures in close proximity to large amounts of vegetation, which in turn increases the risk of wildfire (NWUIFPP undated).

5.4.5 Vulnerability Assessment – James City County

The PHMPC conducted a vulnerability analysis for each critical hazard that was identified. As several of these hazards are prone to occur in any part of the County, the exposure associated with tornados and winter storms is assumed to include the entire County. This section describes the method used to perform the vulnerability analysis for each hazard and then lists the results.

Flooding – James City County

The County provided a flood layer, a tax parcel layer, and a tax assessor database. These layers were overlaid to determine the number of parcels that intersect the 100-year floodplain. The tax assessor database was used to determine the improvement values of these properties.

The analysis showed that there are 2,133 parcels that intersect the 100-year floodplain. These parcels have an improvement value of $979,665,400.

FEMA has developed a concept to highlight the impact that repetitively flooded structures have had on the NFIP. The term "repetitive loss," as applied to the NFIP, refers to any property for which two or more flood insurance claims in excess of $1,000 each in a 10-year period of time have been paid. In 1998, FEMA reported that the NFIP's 75,000 repetitive loss properties have already cost $2.8 billion in flood insurance payments and numerous other flood prone properties continue to remain at high risk in the nation's floodplains. While these properties make up only one percent of the flood insurance policies currently in force, they account for 30 percent of the country's flood insurance claim payments. A report on repetitive loss structures completed by the National Wildlife Federation found that 20 percent of these structures are listed as being outside of the 100-year floodplain (Conrad et al. 1998).

Including flood insurance claims paid as a result of flood damage caused by Hurricane Isabel in 2003, FEMA has identified seven structures as repetitive loss structures in James City County.

Hurricane – James City County

Hazards U.S. – Multi Hazard (HAZUS$^{®MH}$) was utilized to perform a wind hazard analysis for the entire Peninsula region. HAZUS$^{®MH}$ software is a multi-hazard loss estimation program that was developed under a cooperative agreement between the National Institute of Building Sciences and FEMA. The current version of HAZUS$^{®MH}$ has the ability to calculate earthquake, wind, and flood hazards as well as potential economic losses associated with these hazards. The software is designed with the flexibility to perform loss estimations at three different levels. Level 1 utilizes all default parameters built into the software. Levels 2 and 3 require user defined scenarios and building inventory data. For the purpose of this Plan, a Level 1 wind analysis was performed to calculate the wind hazard for each Peninsula community. The probabilistic scenario activates a database of many thousands of storm tracks and intensities. This scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year.

Table 5.4.5a lists the total dollar value of exposed structures for James City County. The default data set provided with the HAZUS$^{®MH}$ software is based on the 2002 Census data. This analysis depicts the probability of occurrence and can generally be used estimate potential damages due to high winds.

Table 5.4.5a-Total dollar value of Exposed Structures from HAZUS®MH – James City County

Occupancy Type	Value of Exposed Structures ($1,000)
Residential	$3,111,100
Non-Residential	$740,910
Total	**$3,852,010**

The probabilistic analysis generated with the HAZUS®MH software utilized the same building stock information listed above. The probabilistic scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year. The probabilistic method was used to generate loss estimations of storms with specific recurrence intervals: 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year. Since residential structures comprised a significantly large percentage of the occupancy classification these data are presented in Table 5.4.5b below.

Table 5.4.5b-Summary of Probabilistic Analysis – Residential Structures – James City County

Return Period	Residential Building Damage – Number of Buildings			
	Minor	Moderate	Severe	Destruction
10-year	10	0	0	0
20-year	83	3	0	0
50-year	630	37	2	0
100-year	58	2	0	0
200-year	5,029	1,113	74	66
500-year	7,400	3,235	578	533
1000-year	7,442	3,554	735	700

Tornado Vulnerability – James City County

The facilities and building stock that were identified as exposed under hurricane hazards are also exposed to tornado hazards. Tornados are random natural events that strike with little warning but are associated with thunderstorms and hurricanes. No damage estimates have been created for tornados that might strike James City County.

Wildfire – James City County

The Wildfire Risk Assessment data, provided by the Virginia Department of Forestry, was utilized to estimate the wildfire risk for James City County. This data layer was overlaid with the County's tax parcel mapping in order to estimate the value of at risk structures. The VDOF also provided the number of wildfire incidences reported from 1995 to 2001.

According to the VDOF, no incidences of wildfire were reported for James City County from 1995 to 2001. Analysis of the County resulted in 13,678 parcels intersecting a high wildfire zone. These parcels have a total improvement value of $3,881,690,400.

Critical Facilities

In order to assess the vulnerability of a community to natural hazards, the PHMPC conducted an inventory of James City County structures and critical facilities (Appendix E). Critical facilities are those facilities that warrant special attention in preparing for a disaster and/or facilities that are of vital importance to maintaining citizen life, health, and safety during and/or directly after a disaster event. The inventory of critical facilities for James City County includes emergency response facilities such as police stations, fire departments, emergency medical service stations (EMS), public facilities including schools and local government buildings. Those facilities that are geographically located within an identified hazard zone are listed below (Table 5.4.5c).

Table 5.4.5c- Critical Facilities at Risk - High Wildfire Hazard Zone

Name	Code	Number
Fire Station 5	FR	3
Fire Station 3	FR	5
Law Enforcement Center	PO	1
Jamestown High School	SC	5
James River Elementary School	SC	13

Source: AMEC
Critical Facility Key Code, see Appendix E

5.4.6 Capability Assessment – James City County

As an additional tool to assist with the examination of the hazards identified and to evaluate the community's ability to plan, develop, and implement hazard mitigation activities, the planning team developed a local capability assessment for James City County. This assessment is designed to highlight both the codified, regulatory tools available to the community to assist with natural hazard mitigation as well as other community assets that may help facilitate the planning and implementation of natural hazard mitigation over time. The following Capability Assessment Matrix has been used as a basis for James City County's mitigation plan.

Table 5.4.6 - Capability Matrix – James City County

	James City County
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	Yes
-Effective Flood Insurance Rate Map Date	2-6-91
-Substantial Damage Language	Yes, but not called "substantial damage"
-Certified Floodplain Manager	No

	James City County
-Number of Floodprone Buildings	200
-Number of NFIP policies	476, as of 12/03
-Maintain Elevation Certificates	Yes
-Number of Repetitive Losses	7
CRS Rating	Class 9
Stormwater Program	Yes
Building Code Version Full-time Building Official	VUSBC (IBC 2003) Yes
- Conduct “As-built” Inspections	Yes
- BCEGS Rating	3
Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes
-Storm Ready Certified	No
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	Yes, just for Surry
-Emergency Notification (R-911)	Yes
-other (e.g., cable override)	CERT, cable over-ride
GIS system	Yes
-Hazard Data	Yes
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	Yes
Property Owner Protection Projects	Yes
Critical Facilities Protected	Not fully
Natural Resources Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

Form of Governance

James City County is divided into five election districts, each of which is represented by an individual who serves on the Board of Supervisors for four years. Current terms are staggered, with representatives from three of the districts elected in one year and representatives from the other two districts elected two years later. The Board of Supervisors passes all laws and determines all policies that govern the County. The Board appoints a County Administrator, most boards and commissions, appropriates funds for County operations, and generally oversees all County functions. The County Administrator is the chief administrative officer of the County and is responsible for executing Board policies. The Administrator acts as Clerk to the Board and handles the daily administrative operations of the County, as well as its long-range and strategic planning.

Guiding Community Documents
James City County has a range of guidance documents and plans for each of their departments. These include a comprehensive plan, strategic plans, streetscape policy guide, community appearance guide, and emergency management plans. The County uses building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the County guides its' future is through policies laid out in the Comprehensive Plan.

2003 Comprehensive Plan

James City County's *2003 Comprehensive Plan* features the following:

- A long-range plan for the physical development of the County by focusing on controlling residential growth while preserving the County's natural beauty, improving education and maintaining public services and a healthy economy.
- Land Use designations describing Conservation Areas as "critical environmental areas where ordinary development practices would likely cause significant environmental damage." These lands include wetlands, marshes, flood hazard areas, steep slopes, critical plant and wildlife habitats, and streambanks. Conservation areas should remain in their natural state. Development, if it occurs, should consider negative impacts and methods to mitigate or eliminate these impacts.
- Environmental concerns including: decreasing water supply and quality; increased soil erosion and stormwater runoff, loss of scenic vistas, destruction of wildlife habitats, deforestation, air pollution and loss of agricultural lands.
- Environmental goals focused on air, land, noise, solid waste, and water elements, including water quality, protecting wetlands, marshes and rivers from degradation, protecting shoreline property from erosion and minimizing the need for streambank and shoreline erosion controls. The floodplain management regulations are cited as contributing toward both water quality and shoreline erosion control.
- Maps and detailed sections regarding aquatic resources, shoreline and streambank erosion problems and public/private waterfront access areas.

James City County prepared a *Development Potential Analysis Report* in 2002 to identify and quantify the residential development potential of properties located within the County's Primary Service Area (PSA). The Real Estate Assessment Subdivision Data Zone Database was the primary source of reference for identifying parcels and their associated improvement value. A total of 3,850 platted/vacant lots were identified in residential zoning with development potential.

Current development pressure and projects under construction or site plan review are located west of Interstate 64, and primarily in the Berkeley Powhatan and Stonehouse Districts of the County, especially along Richmond Road in the southern part of Stonehouse. A special *Five Forks Study Area Traffic Impact Alternatives Analysis* was conducted in 2004 to identify and analyze the development and redevelopment potential within the Five Forks Area. Five Forks is a developed area in the immediate vicinity of the intersection of John Tyler highway (State Route 5) and Ironbound Road (State Route 615). The study focused on existing traffic conditions and expected traffic impacts associated with four future land use scenarios. Emergency evacuation does not appear to be a factor considered in the study.

Zoning & Development Standards

- Identifies existing Federal and state regulations for wetland, floodplain, and RPA/RMA protection.
- The document outlines required standards for new development and redevelopment based on use and zoning designation.

James City County has adopted a floodplain management ordinance that exceeds the minimum requirements of the NFIP. The Flood Zone District is designated as an Overlay District in County Code, Chapter 24, Division 3. The community has seven repetitive losses through the NFIP. Manufactured homes are not a permitted use in the floodplain, although there are some existing units in the floodplain and replacements are allowed with freeboard and proper anchoring. The ordinance outlines very specific hazardous materials/uses that are not permitted in the overlay district, including oil and oil products, radioactive materials, and specific poisons.

One foot of freeboard above the BFE is required for structures in the floodplain. Substantially damaged structures are addressed in §24-602 of the ordinance, entitled “Existing Structures in Floodplain Districts.” Although the NFIP term “substantial damage” is not used, the resultant requirements are comparable. Flood hazard information is not currently noted on site plan applications or checklists, or the building permit application.

James City County participates in the NFIP’s Community Rating System, and has maintained a Class 9 rating since 1992, rewarding property owners, countywide, with a five percent reduction in flood insurance premiums.

The County’s Development Review Committee (DRC), a subset of the Planning Commission reviews large or complicated development plans proposed in the County. Emergency Preparedness, Police and Fire do not participate in DRC reviews; however, the DRC does hear presentations from County staff if there are specific issues requiring attention.

Stormwater Program

The County Environmental Division’s role is to protect the natural resources through effective management of public and private land development and enforcement of environmental activities. Through Land Disturbance permits, the division enforces ordinances related to stormwater management, erosion and sediment control and the Chesapeake Bay Preservation Act. The division also promotes watershed management through development of watershed plans, specifically for Powhatan Creek and Yarmouth Creek.

To meet the requirements of the Chesapeake Bay Preservation and Sediment Control Ordinances, virtually all new commercial and residential developments in James City County require the construction of one or more Best Management Practice (BMP) facilities. The majority of BMP facilities are wet or dry ponds but a few are infiltration-type facilities. These facilities store stormwater runoff and treat the water by either slowly releasing the water over a 24-hour period or infiltrating it into the ground.

All BMP facilities require periodic maintenance to ensure that they function as designed and to prolong their useful life. Responsibility for this maintenance is assigned to the BMP owner(s) through a Declaration of Covenants for Inspection/Maintenance. In order to assist BMP owner(s) with the maintenance needs of their BMP, the Environmental Division inspects the BMPs on an annual basis and provides the results of the inspection to the owner(s). The staff also has information available that describes how to maintain the facilities and is available to make presentations to Homeowner Associations.

Public Education

Among the readily available public outreach mechanisms for James City County, the website (http://www.jccegov.com/index.html) provides residents with pertinent information, a property information tool and answers to numerous Frequently Asked Questions (FAQs). The County also posts most of its guiding documents, including the Comprehensive Plan.

The County has many different types of materials available for residents, businesses, teachers, youth, and adult groups. Emergency Preparedness offers refrigerator magnets, a Surry Nuclear Power Station calendar that includes siren testing dates, numerous materials on family disaster planning, and an emergency information flyer. The Surry calendar is distributed to all households within a 10-mile radius of the facility. Fire safety programs and presentations at fairs, shopping centers and community groups are regularly used to share information with the public. Regular programming on County television stations and the County emergency management hotline are additional resources that James City County residents can use to answer questions or learn more about hazards in the area.

County Development Management distributes a *Notice of Flood Hazard* flyer to owners of buildings located in or near floodplains in the County as part of the annual County Flood Hazard Awareness Program. The public library maintains extensive literature on flood hazards and floodplain development.

Emergency Preparedness

Emergency Alert System (EAS) is a national civil emergency alert system that uses message relays between member radio and television stations to inform the public about immediate threats to national security, life, and property. EAS is now routinely used for severe weather warnings and can also be employed to disseminate Amber Alerts for missing children. The enhancement is an initiative of Governor Warner's Secure Virginia Panel designed to improve statewide preparedness, response, and recovery capabilities for emergencies and disasters. Governor Mark R. Warner announced June 5, 2004, that Virginia will enhance its public warning capabilities with a new satellite-based system that can rapidly transmit EAS messages throughout the Commonwealth. In James City County, warnings are disseminated by radio, TV, weather radio and by police and fire vehicles equipped with public address systems.

The County has contracted with a private radio station for future public disaster-related information specific to James City County. In cooperation with Williamsburg, James City County is installing digital text alert systems for severe weather in public buildings, including schools and libraries. The system incorporates Thunder Eagle Alert System technology which relays weather, Amber and emergency alerts to email, text messaging cell phones and pagers for a large group of people, possibly including government officials, broadcast engineers and emergency management staff. Emergency management officials work closely with the School Board's emergency planner before, during and after disasters. James City County also has a Reverse 9-1-1 system to facilitate telephone contact with select groups of residents based on the nature and location of an impending event. The County maintains an ongoing database of County emergency response incidents and each incident is geographically referenced.

James City County's evacuation planning is prepared by the Virginia Department of Transportation. Phase 1 and Phase 2 evacuation routes are shown and discussed online at http://www.virginiadot.org/comtravel/hurricane-evac-hro.asp. Special needs residents can sign up with Heads Up, James City County's assistance program for residents with special needs such as hearing impaired or wheelchair bound. The confidential database system is activated should emergency personnel need to respond to a medical emergency at an address or during a countywide disaster. Retirement and nursing homes in the area have been extremely pro-active in preparing their facilities to shelter residents in-place during disasters.

James City County's Community Emergency Response Team (CERT) program helps the community respond to disasters during the first 72 hours following a disaster when flooded roads, disrupted communications, and emergency demand outweigh local emergency services. The purpose of CERT training is to provide private citizens with basic skills to handle virtually all of their own needs and then to respond to their community's needs in the aftermath of a disaster.

The Citizen Fire Academy is designed to introduce citizens to the Fire Department, its mission and role in public safety, and to train citizens on their role and responsibilities in fire and life safety. Participants receive information on disaster programs and response, fire extinguisher training, CPR, and how to access the Enhanced 911 system in the most efficient manner.

The Neighborhood Connections program provides a mechanism for relaying pertinent information to homeowners' association leaders in remote areas, with the expectation that these persons could further distribute the information to all residents.

Other Mitigation Activities

Following Hurricane Isabel, the County requested and received FEMA HMGP funds to elevate three homes in Chickahominy Haven. The neighborhood contains many of the County's repetitive losses.

The County has installed diesel generator backup power at the EOC and tied communications to the County intra-net. Satellite service and a standard outside antenna provide additional backup during emergencies. Ham radio operators in the EOC assist with communications during events.

Every one of the 10 schools in the County is approved by the American Red Cross to operate as an emergency shelter. The primary shelter at the James City County/Williamsburg Community Center is configured to receive an emergency generator in case of power outages. Jamestown Elementary School and Stonehouse Elementary School are also prepared for an emergency generator.

The James City County Environmental Division has recently initiated a drainage improvement program, previously authorized by the Board of Supervisors. The purpose of this program is to correct existing drainage and erosion problems that are adversely impacting landowners and the environment. The Environmental Division works with landowners and homeowner associations in the design, contracting and supervision of the restoration work. More than a dozen sites included as projects within James City County have already been identified and prioritized for 2005.

5.5 York County Profile

The following sections present a detailed assessment of critical hazards that affect York County. Understanding these hazards will assist the Peninsula region in its process of identifying specific risks and developing a mitigation strategy to address those risks.

5.5.1 Flooding – York County

The geographic location of York County makes it extremely susceptible to coastal flooding. Storms associated with coastal flooding include tropical cyclones and nor'easters. These types of events typically drop large amounts of rain and generate high winds that result in storm surge. Storm surge is essentially the water that is pushed toward the shore by the persistent force of the winds of an approaching storm. It should be noted that astronomical tides occur independent of climatic conditions. Depending on the tide level at the time of land-falling storms, surge may be elevated. Flash flooding and urban flooding are also a concern within the County limits.

As part of the NFIP, FEMA created a Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for York County. In addition, the NCDC tracks the occurrence of flooding events for communities across the nation. York County has developed surge elevations for its parcel data set. All of these data sources were utilized in developing the hazard identification and vulnerability assessment.

FEMA published a FIS for York County, dated December 16, 1988. The FIRMs, which accompany this FIS delineate the 100- and 500-year flood hazard boundaries for flooding sources identified in areas of growing development or areas predicted to have future development, at the time of the report. A detailed wave height analysis was developed in order to delineate the 100- and 500-year flood hazard boundaries for the County. This analysis resulted in a 100-year stillwater elevation of 8.5 feet for the County and a maximum 100-year wave crest of 11 to 13 feet. The significant flood events outlined in the FIS are given below in Table 5.5.1a.

Table 5.5.1a- Significant Flood Events – York County

Date	Storm	Tide Elevations
August 1933	Hurricane	Max tide heights averaged 8 feet
April 1956	Nor'easter	Not given
October 1957	Hurricane – Not Named	Not given
September 1960	Hurricane Donna	Not given
March 1962	Nor'easter	Max tide heights averaged 6.8 feet

Source: FEMA 1988

The NCDC operated by NOAA keeps a record of significant weather related events and damage estimates for the entire country. Listed below (Table 5.5.1b) are the significant events that have affected York County, according to that database.

Table 5.5.1b- NCDC Listed Significant Flood Events –York County

Date	Event	Precipitation	Comments
1989 (not in NCDC database)	Thunderstorm with urban flooding	Not given	▪ Urban flooding costs estimated at $500,000 in York County.
September 22, 1994	Coastal Flooding	Not given	▪ Caused minor local flooding along Water Street in Yorktown
April 23, 1997	Coastal Flooding	Not given	▪ Minor coastal flooding was reported in portions of Newport News and York County
January 27, 1998	Coastal Flooding	Not given	▪ Residential homes sustained severe damages ▪ Gale force winds caused damage to power lines which caused power outages locally
February 4, 1998	Coastal Flooding Nor'easter	Not given	▪ Caused severe flooding ▪ Buildings were evacuated ▪ Widely spread power outage ▪ $314,000 in costs incurred by York County government
September 15 to 17, 1999	Hurricane Floyd	12 to 18 inches	▪ Numerous roads washed out due to flooding ▪ Flooding considered 500-year flood ▪ Enormous crop damage

As with the entire Peninsula planning area, there are obvious data gaps when combining the FIS and NCDC databases. Recent, noteworthy urban-type flood events in the County have included:

- Hurricane Floyd (1999) affected the neighborhoods of Tabb Lakes, Coventry, Running Man and Foxwood. Insufficiently sized culverts, culvert blockages, and intense rainfall contributed to the drainage problems.
- July 24, 2000, intense rainfall affected the Tabb Lakes and Coventry subdivisions.
- Hurricane Isabel (2001) resulted in flooding of some streets and intersections in many of the same subdivisions listed above, but no significant flooding of structures was noted.

The County has been working with residents recently to identify and abate these drainage problems. As a result of Hurricane Floyd, Newport News Waterworks made changes to their reservoir management practices to be more proactive in adjusting reservoir elevations ahead of storm systems that are predicted to produce excessive rainfall amounts. Residents indicate that Little Brick Kiln Creek, which is on the Newport News/York County boundary, is a major outfall for several York County tributaries with very low slopes. Maintenance of the creek by all stakeholders (including the U.S. Army which also has land holdings in the area) is critical to maintaining sufficient drainage using existing infrastructure.

5.5.2 Hurricanes – York County

The FIS for York County identified four historic hurricanes that affected the County (see Table 5.5.1a above); however, specific damage estimates were not given. The NCDC dataset listed five hurricanes for York County for the period between 1950 to June 2004. These storms are listed in Table 5.4.2. County records and other National Weather Service data provide dates of earlier storms and identify a number of hurricanes to include the damaging event in August 1933. These storms are included in Table 5.5.2.

Hurricane Fran (1996) created power losses to 140,000 people across the Peninsula. Additionally, four people died within York County as a result of Fran.

Typical York County damage from Isabel where trees fell into power lines

Hurricane Floyd (1999) moved through the area dropping 18 inches of rain within 24 hours. Trees and power lines were knocked down and roads were flooded; over 5,500 homes were left without power.

Hurricane Isabel made landfall on September 18, 2003, as a Category 2 hurricane near Drum Inlet, North Carolina. Hurricane Isabel is considered to be one of the most significant tropical cyclones to hit this area since hurricane Hazel (1954) and the Chesapeake-Potomac Hurricane of 1933. Isabel produced storm surges six to eight feet above normal high tide levels and is directly responsible for 10 deaths in Virginia and indirectly responsible for 22 deaths. Isabel caused widespread wind and storm surge damage in eastern North Carolina and southeastern Virginia, currently estimated at $925 million in Virginia. All of the above data was taken from the NOAA Tropical Cyclone Report for Hurricane Isabel (Beven and Cobb, 2004).

In York County, Hurricane Isabel reportedly destroyed 55 homes. Debris removal alone cost the county over $10.6 million. There were 900 flood insurance claims through the NFIP, which represent only a small portion of the total number of homes that were damaged by floodwaters. The Small Business Administration provided loans for home repair totaling $9 million, and loans for businesses totaling $909,000. FEMA housing assistance other needs assistance in the County totaled $2.6 million

Table 5.5.2- Historic Hurricanes – York County

Date	Storm Name	Category	Descriptions
August 23,1933	Chesapeake-Potomac Hurricane	Category 1/Tropical Storm	▪ Extensive damage to areas along the York River and Chesapeake Bay. Tide levels of 6-9 feet above MLLW over a large portion of the Bay. Peak wind gusts at Cape Henry were 88 mph.
August 19, 1985	Danny	Extratropical System	▪ Tracked over York County
September 6, 1996	Fran	Tropical Storm	▪ 4 deaths in York County associated with the storm ▪ Water Street and other areas flooded ▪ High winds, and 140,000 on the Peninsula without power.
July 12, 1996	Bertha	Tropical Storm	▪ 170,000 people on the Peninsula without power. Tracked over York County.
August 29, 1998	Bonnie	Tropical Storm	▪ 51,000 people on Peninsula without power.
September 1, 1999	Dennis	Hurricane/Tropical Storm	▪ Prolonged period of tropical cyclone ▪ Highest sustained winds at Langley 52 mph ▪ Tide 3 feet above normal ▪ Coastal flooding ▪ 2 to 5 inches of rain ▪ $27,000 damage
September 15, 1999	Floyd	Category 1/Tropical Storm	▪ Spawned 2 tornados ▪ Hundreds of downed tress ▪ Tide 3.9 feet above normal ▪ Numerous roads washed out ▪ $99.4 million in property damage over the entire affected area ▪ 18” of rainfall in York County
September 18, 2003	Isabel	Category 1/Tropical Storm	▪ Hundreds of downed tress ▪ Loss of power ▪ Damaged residents and businesses ▪ Greatest storm surge since Hazel
August 18, 2004	Charley	Hurricane	▪ Uprooted of trees and downed numerous power lines ▪ Over 2 million Virginians without power ▪ Heavy rain and wind gusts
August 30, 2004	Gaston	Tropical Depression	▪ Hard rains that produced flooding ▪ Roads under water ▪ Power outage (99,600 statewide) ▪ 2 F0 Tornados confirmed in York County.
September 8, 2004	Frances	Hurricane	▪ Generated 9 tornados in Central Virginia ▪ High winds ▪ Large amounts of rainfall/flooding
September 17, 2004	Ivan	Hurricane	▪ Spawned unconfirmed tornados ▪ Power outage (66,000) ▪ Heavy rain/flooding
September 28, 2004	Jeanne	Hurricane	▪ Flash flooding/heavy rainfall ▪ Power outage

5.5.3 Tornados – York County

York County has experienced five tornados over the period of 1896 to 2003 (Table 5.5.3), which have caused a variety of damage. The most significant tornado occurred on October 14, 1986, which generated wind of 110 mph and cause $1.8 million in damages over the entire affected area.

Table 5.5.3- Historic Tornados – York County

Date	Magnitude	Deaths	Injuries	Descriptions
July 8, 1896	Not Given	Not Given	2-5	▪ Spawned by a hurricane ▪ Barns and small houses destroyed
May 8, 1984	Not Given	Not Given	Not Given	▪ Spawned by severe thunderstorms ▪ Destroyed three mobile homes
October 14, 1986	F2	Not Given	Not Given	▪ Down burst of 110mph ▪ Damages of $1.8 million over entire affected area
August 7, 1993	F0	0	0	▪ Damage to several structures in the Lackey area.
August 2003	F0	0	0	▪ Damage to structures in Running Man subdivision in the Tabb area, winds in the 80 MPH range.
August 30, 2004	F0 (2)	Not Given	Not Given	▪ Associated with Gaston

5.5.4 Erosion – York County

York County is unique among Peninsula communities because the shoreline erosion hazard has historically caused more damage, and has the potential for additional damage in the future. The hazard, however, is pertinent from a land use perspective only and poses little threat to human life, health or safety. Furthermore, the erosion hazard is a secondary hazard caused by storms and sea level rise. The uniqueness of York County's erosion hazard merits additional consideration in this section, and is also discussed and mapped in detail in the County's 2025 Comprehensive Plan which should be referenced for additional information and graphics. The information below is taken primarily from the Comprehensive Plan.

York County's shoreline consists of sheltered fine sand beaches, coarse sand beaches, exposed tidal flats, sheltered tidal flats, fringing intertidal marshes, supratidal marshes partially protected by elevation, and freshwater marshes and swamps. There are approximately 2,308 acres of marshes in the County.

York County encompasses approximately 207 miles of shoreline. The upper County drains via a system of streams and rivers, to the southern reach of the York River. This area is characterized by rolling terrain with well-drained soils and elevations up to 100 feet above mean sea level. In isolated areas, moderate to severe erosion has been noted. The lower County drains via a system of creeks and rivers to the Chesapeake Bay. The lower County section of shoreline includes

Wormley Creek, Back Creek, Chisman Creek, a portion of the Poquoson River, and the western shore of the Chesapeake Bay. Low flat lands with a relatively high water table characterize the topography of the lower County.

The impacts of natural and human activities on the shoreline can be measured by erosion rates, which are used to determine the most appropriate method to address erosion. The Chesapeake Bay Local Assistance Department suggests classifying eroding shorelines as slight (less than 1 foot per year), moderate (1 to 3 feet per year), or severe (more than 3 feet per year.)

In York County, the western shore of the Chesapeake Bay presents a unique challenge. The two areas with severe erosion are Reach 109 (the Bay Tree Beach/York Point area) and Reach 30 (the Waterview Road area west of the entrance to the Thorofare), both of which historically experience moderate to severe erosion rates of up to 3.5 feet per year. Although there is residential and industrial development along both of these shorelines, the erosion does not appear to be associated with the development. Most of the homes were built more than 10 years ago and are set back from the shoreline, although some homes along Dandy View Lane and Waterview Road are endangered. The erosion is due in large part to wave action associated with the physical alignment of the shore and prevailing storms. The York County Wetlands Board has approved several permits along Reach 30 for riprap, breakwaters, and marsh toe stabilization structures. The Bay Tree Beach area is much less developed than the Sandbox area. Most of these properties are not developed because the soils and high water table preclude on-site sewage disposal systems.

The rate of erosion in the remainder of the County along the York River is slight to moderate. The shoreline at the mouth of the river is vulnerable to the high-energy waves generated by the dominant northeast storms. The Yorktown historical area and recreational beach are along this shoreline. There is an ongoing project to stabilize the beach with a combination of methods, including riprap, breakwaters, beach nourishment, and vegetation. In addition, just south of Yorktown, the National Park Service is pursuing a project to stabilize the shoreline at the base of the significant bluff in the Moore House Road area.

5.5.5 Wildfire - York County

Many wildfires are caused by human acts like arson or careless accidents, or through natural occurrences, such as lightning strikes. Wildfire danger can vary greatly season to season and is often exacerbated by dry weather conditions. The high productivity and the tendency for the previous year's growth to remain interspersed among the current year's growth create a wildfire danger. VDOF has created Fire Risk Assessment Maps designed to help communities determine areas with the greatest vulnerability to wildfire.

The Wildfire Risk Assessment Map (Appendix B) delineates the aerial extent of wildfire vulnerability within York County. Approximately 34,322 acres (50 percent) of the County falls in a high wildfire risk area. York County determined that 5,906.5 acres (17 percent) of that total are federally-controlled land. Parameters used to establish these risk boundaries are based on land use, population density, slope, land cover and proximity to roads. The proximity of the tree lines or brush to the highway or roadway is also included in the wildfire risk analysis to capture the human/wildfire causal relationship. Travel corridors increase the probability of human presence across a landscape, thereby increasing the probability of wildfire ignition. As such, areas closer to roads are much more likely to attain a higher ignition probability.

York County is currently experiencing an accelerated development rate. Land that once was rural and relatively inaccessible is now either under development or planned for development. Although the clearing of land for development removes potential fuel sources for wildfire, the wildfire hazard is not necessarily diminished because human access to the area is significantly increased. This development trend expands the wildland/urban interface, which places structures in close proximity to large amounts of vegetation, which increases the risk of wildfire (NWUIFPP undated).

5.5.6 Vulnerability Assessment – York County

The PHMPC conducted a vulnerability analysis for each critical hazard threatening York County. As several of these hazards are prone to occur in any part of the County, the exposure associated with tornados and winter storms is assumed to include the entire County. This section describes the method used to perform the vulnerability analysis for each hazard and then lists the results.

Flooding – York County
The York County Computer Support Services Division provided the tax parcel layer and tax assessor database for the entire County. They also provided a digital copy of the FEMA delineated floodplain information for the County. The detailed and approximate 100-year flood hazard layers were merged into one layer and intersected with the parcel layer. Any tax parcel that intersected the delineated floodplain was considered to be inside the floodplain and its building improvement value was added to the total property value in the 100-year floodplain.

Based on data from Spring 2005, the county parcel layer contains a total of 24,890 parcels. Approximately 4,265 of these parcels intersect the 100-year flood hazard boundary, which results in an at risk value of $1,393,066,000. Furthermore, York County provided an analysis of the hurricane storm surge zones based on digitized data provided by the Army Corps of Engineers. That study estimates that 8,929 parcels are located in a hurricane Category 4 storm surge zone, with an at-risk value of $2,225,806,700.

FEMA has developed a concept to highlight the impact that repetitively flooded structures have had on the NFIP. The term “repetitive loss,” as applied to the NFIP, refers to any property for which two or more flood insurance claims in excess of $1,000 each in a 10-year period of time have been paid. In 1998, FEMA reported that the NFIP's 75,000 repetitive loss properties had already cost $2.8 billion in flood insurance payments and numerous other flood prone properties continue to remain at high risk in the nation's floodplains. While these properties make up only one to two percent of the flood insurance policies currently in force, they account for 40 percent of the country's flood insurance claim payments. A report on repetitive loss structures completed by the National Flood Insurance Program found that 20 percent of these structures are listed as being outside of the 100-year floodplain (Conrad et al. 1998).

Including flood insurance claims paid as a result of flood damage caused by Hurricane Isabel in 2003, FEMA has identified 30 structures as repetitive loss structures in York County.

Hurricane – York County

Hazards U.S. – Multi Hazard (HAZUS$^{®MH}$) was utilized to perform a wind hazard analysis for the entire Peninsula region. HAZUS$^{®MH}$ software is a multi-hazard loss estimation program that was developed under a cooperative agreement between the National Institute of Building Sciences and FEMA. The current version of HAZUS$^{®MH}$ has the ability to calculate earthquake, wind, and flood hazards as well as potential economic losses associated with these hazards. The software is designed with the flexibility to perform loss estimations at three different levels. Level 1 utilizes all default parameters built into the software. Levels 2 and 3 require user defined scenarios and building inventory data. For the purpose of this Plan, a Level 1 wind analysis was performed to calculate the wind hazard for each Peninsula community. The probabilistic scenario activates a database of many thousands of storm tracks and intensities. This scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year.

Table 5.5.5a lists the total dollar value of exposed structures for York County based on the 2002 Census data. Although current development trends in York County may render the 2002 Census data somewhat obsolete, this analysis depicts the probability of occurrence and can generally be used to estimate potential damages due to high winds.

Table 5.5.6a- Value of Exposed Structures from HAZUS$^{®MH}$ – York County

Occupancy Type	Value Exposed Structures ($1,000)
Residential	$3,238,262
Non-Residential	$348,300
Total	**$3,586,562**

The probabilistic analysis generated with the HAZUS$^{®MH}$ software utilized the same building stock information listed above. The probabilistic scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year. The probabilistic method was used to generate loss estimations of storms with specific recurrence intervals; 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year. Since residential structures comprised a significantly large percentage of the occupancy classification these data are presented in Table 5.5.5b below.

Table 5.5.6b-Summary of Probabilistic Analysis – Residential Structures – York County

Return Period	Residential Building Damage – Number of Buildings			
	Minor	Moderate	Severe	Destruction
10-year	7	1	0	0
20-year	118	7	1	0
50-year	1,257	111	13	1
100-year	1,754	214	23	5
200-year	6,121	1,732	262	159
500-year	7,679	3,595	960	695
1000-year	6,806	5,229	2,552	2,327

Hurricane Isabel- Structural Damage in York County

Winter/Ice Storm Vulnerability

Snow and ice storms usually associated with coastal storms do occur on the Peninsula (Table 5.5.5c). The weight of snow and ice on utility lines (power, cable, telephone) and trees causes lines to break and tree limbs to fall and break utility lines, block roads, and damage structures. During the Christmas ice storm of 1998, some York County residents were without power through the entire holiday week and into the first week of January. Tree damage that resulted from this storm was significant and the County spent several months in debris cleanup. VDOT, which maintains the Interstate system, also maintains the primary and secondary roads in York County. VDOT is responsible for snow plowing and sanding these roadways. The National Park Service (NPS) manages and maintains the Colonial Parkway, which provides another route to the northern end of York County. NPS can close the parkway when there is a threat of falling trees or when the tree damage is extensive and road conditions are unsafe.

Table 5.5.6c- Recent Winter Storms – York County

Date	Magnitude	Descriptions
March 1993		
January 6, 1996		Property Damage, $50 thousand damage
January 27, 1998		Property Damage, $20 million damage
February 5, 1998		
December 23, 1998	½-inch of ice coated trees, roads, and utility lines.	Power outages, structural damage, and debris removal

Tornado Vulnerability – York County

The facilities and building stock that were identified as exposed under hurricane hazards are also exposed to tornado hazards. Tornados are random natural events that strike with little warning but are associated with thunderstorms and hurricanes.

Wildfire – York County

VDOF was utilized to estimate the wildfire risk for York County. This data layer was intersected with the County's tax parcel mapping in order to estimate the value of at risk structures. Approximately 50 percent of the County is located within the high wildfire risk zone. This area includes 14,584 parcels with an at risk improvement value of $4,711,794,700.

Critical Facilities

In order to assess the vulnerability of a community to natural hazards, the PHMPC conducted an inventory of York County structures and critical facilities (Appendix E). Critical facilities are those facilities that warrant special attention in preparing for a disaster and/or facilities that are of vital importance to maintaining citizen life, health, and safety during and/or directly after a disaster event.

The inventory of critical facilities for York County includes emergency response facilities such as police stations, fire departments, emergency medical service stations (EMS), public facilities including schools and local government buildings. Those facilities that are geographically located within a hazard zone are listed below (Tables 5.5.5d, 5.5.5e, and 5.5.5f).

Table 5.5.6d- Critical Facilities at Risk – 100-Year Floodplain

Name	Code	Number
**Overlook Point	PS	208
Barcroft	PS	169
Brandywine	PS	174
Carys Chapel Rd.	PS	194
Crestwoods	PS	196
Dandy Vac Sta.	PS	199
Hollywood	PS	166
Jonadab Rd.	PS	206
Marlbank Cove	PS	185
Mill Cove	PS	175
Olde Port Cove	PS	182
Seaford Vac. Sta	PS	198
Yorkshire Downs	PS	187

Source: AMEC
Critical Facility Key Code, see Appendix E

Table 5.5.6e- Critical Facilities at Risk – Surge Zone Hurricane Category 4

Name	Code	Number
**Overlook Point	PS	208
Barcroft	PS	169
Belmount Apts	PS	202
Brandywine	PS	174
Calthop Neck Vac	PS	201
Cary's Chapel 2	PS	200
Carys Chapel Rd.	PS	194
Crestwoods	PS	196
Dandy Vac Sta.	PS	199
Dare Heights	PS	215
Dare Vacuum Sta.	PS	213
Hollywood	PS	166
Hornsbyville Rd.	PS	160
Jonadab Rd.	PS	206
Kings Villa	PS	162
Lakes Of Dare	PS	195
Lindsay Landing	PS	207
Marlbank Cove	PS	185
Mill Cove	PS	175
Moss Avenue	PS	167
Olde Port Cove	PS	182
Pinehurst Vac	PS	173
Read Street	PS	158
Running Man 1	PS	183
Running Man 2	PS	189
Scotch Toms	PS	176
Seaford Station Number 6	FR	62
Seaford Vac. Sta	PS	198
Sommerville	PS	163
Tidemill	PS	197
Whispering Winds	PS	184
Yorkshire Downs	PS	187
Yorktown Road	PS	214

Source: AMEC
Critical Facility Key Code, see Appendix E

Table 5.5.6f- Critical Facilities at Risk – High Wildfire Hazard Zone

Name	Code	Number
**Corvette	PS	205
*Colony Pines	PS	220
Banbury Water	PS	210
Baptist Rd.	PS	192
Barcroft	PS	169
Brandywine	PS	174
Calthop Neck Vac	PS	201
Cary's Chapel 2	PS	200
Carys Chapel Rd.	PS	194
Cockletown Road	PS	161
Crestwoods	PS	196
Dare Vacuum Sta.	PS	213
Environmental Services Building	GO	225
Finance Building	GO	227
Ft. Eustis Blvd.	PS	168
General Services	GO	229
Goosley Road	PS	177
Grafton High/Middle School	SC	58
Grafton Woods	PS	172
Griffin-Yeates Center	GO	228
Hollywood	PS	166
Hornsbyville Rd.	PS	160
Kiln Creek 2	PS	181
Lackey	PS	186
Landfill	PS	165
Lightfoot Sta.	PS	212
Lindsay Landing	PS	207
Lodge Road	PS	178
Marlbank Cove	PS	185
Mill Cove	PS	175
Moss Avenue	PS	167
Mount Vernon Elementary School	SC	56
Olde Port Cove	PS	182
Oriana Road	PS	164
Penniman East	PS	155
Pierpoint Place	PS	156
Pinetree Road	PS	151
Public Safety Building	GO	223
Queens Lake Middle School	SC	137
Queenslake	PS	217
Read Street	PS	158
Road Water Sta.	PS	209
Route 17	PS	170

Name	Code	Number
Royal Grant	PS	152
Running Man 1	PS	183
Schooner Blvd	PS	204
Scotch Toms	PS	176
Seaford Station Number 6	FR	62
Solid Waste Management Center	GO	224
Tabb High School	SC	80
Tabb Library	LB	222
Tabb Middle School	SC	55
Tabb Station Number 2	FR	134
Tidemill	PS	197
Williamsburg Hosp.	PS	203
York High	PS	179
York/Poquoson Courthouse	GO	226
Yorktown Elementary School	SC	61
Yorktown Library	LB	221
Yorktown Middle School	SC	63
Yorktown Road	PS	214
Yorktown Station Number 4	FR	122

Source: AMEC
Critical Facility Key Code, see Appendix E

This inventory highlights that some critical facilities, such as the Barcroft Pump Station, are in areas subject to multiple hazards. This should be taken into consideration when action is taken to protect York County's critical facilities.

5.5.7 Capability Assessment – York County

As an additional tool to assist with the examination of the hazards identified and to evaluate the community's ability to plan, develop, and implement hazard mitigation activities, the planning team developed a local capability assessment for York County. This assessment is designed to highlight both the codified, regulatory tools available to the community to assist with natural hazard mitigation as well as other community assets that may help facilitate the planning and implementation of natural hazard mitigation over time. The following Capability Assessment Matrix has been used as a basis for York County's mitigation plan.

Table 5.5.7 - Capability Matrix – York County

	York County
Comprehensive Plan	Yes
Land Use Plan	Yes, part of the Comprehensive Plan
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
Floodplain Management Ordinance	Yes
-Effective Flood Insurance Rate Map Date	12-16-88

	York County
-Substantial Damage Language	Yes
-Certified Floodplain Manager	No
-Number of Floodprone Buildings	4,265 parcels
-Number of NFIP policies	2,079
-Maintain Elevation Certificates	Yes
-Number of Repetitive Losses	30
CRS Rating	Class 9
Stormwater Program	Yes
Building Code Version Full-time Building Official	VUSBC (IBC 2003) Yes
- Conduct "As-built" Inspections	Yes
- BCEGS Rating	3
Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes
-Storm Ready Certified	No
-Weather Radio Reception	Yes
-Outdoor Warning Sirens	Yes, just for Surry
-Emergency Notification (R-911)	Route alerting plans and an automated system in the planning phase.
-other (e.g., cable override)	Cable override & agreement with radio station.
GIS system	Yes
-Hazard Data	Yes
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	Yes
Property Owner Protection Projects	Yes
Critical Facilities Protected	Partially
Natural Resources Inventory	Yes – limited
Cultural Resources Inventory	Yes – limited
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Web site & online Customer Service Utility
Environmental Education Program	Yes

Form of Governance

The York County Board of Supervisors is comprised of five elected citizens, one from each of the five election districts. Supervisors serve four-year terms with the Chairman and Vice

Chairman elected annually by the five-member board. The Board of Supervisors serves, by law, as the governing body of the County, charged with administering County functions which include: preparation of the budget and appropriation of funds; appointing members of various boards and committees; levying taxes; constructing and maintaining County buildings; adopting the comprehensive land use plan and approving and enforcing related ordinances; and adopting and enforcing ordinances for police, sanitation, health, and other regulations permitted by state laws.

Guiding Community Documents

York County has a range of guidance documents and plans for its departments. These include a comprehensive plan, a build-out study, a citizen's guide on land development, transportation studies, Yorktown Historic District and Design Guidelines, and emergency management plans. The County uses building codes, zoning and, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the County guides its future is through policies laid out in the Comprehensive Plan.

Charting the Course to 2025: The County of York Comprehensive Plan

The Code of Virginia requires all cities and counties in the state to have a comprehensive plan and to review it every five years to determine if it needs to be revised. York County's *Comprehensive Plan, first adopted in 1991, and updated in 1999 and 2005,* features the following:

- The long-range plan for the physical development of the County, including what kind of development – single-family residential, commercial, multi-family residential, industrial, etc. – is considered desirable and appropriate for each area of the County.
- Data that guides development to appropriate areas of the County based on the carrying capacity of the land, the existing development character, the presence of infrastructure and public facilities, and natural resources.
- Extensive public participation efforts. The Comprehensive Plan Review Citizen Input Process used for the 1999 plan update received an Achievement Award from the National Association of Counties in 1997.
- Environmental goals focused on air, land, noise, solid waste, and water elements, including water quality, protecting wetlands, marshes and rivers from degradation, protecting shoreline property from erosion and minimizing the need for streambank and shoreline erosion controls.
- Maps of wetlands, flood hazard areas, Chesapeake Bay Preservation Areas, watershed protection areas, areas of high soil erodibility, areas with high water tables, areas with shrink/swell soils and areas with steep slopes.
- An estimate of maximum build-out population, the total number of people who would be living in York County if all the residential land were developed at its highest allowable density. The plan established 80,000 as the desirable maximum build-out population, and residential land use densities were established and applied to areas of the County with the intent of achieving this goal. The County appears to be on track toward meeting this goal,

with an estimated maximum build-out figure of approximately 81,000 under almost any realistic development scenario.

- Plans for continued growth and development in designated areas, including but not limited to:
  - South County; south of Ft. Eustis Blvd., and east of Rte. 17
  - North County; Lightfoot exit off of Interstate 64
  - Potential Mixed Use areas identified along Route 17 on Denbigh Boulevard, and in the Lightfoot and Skimino areas of upper County.
- Citizen comments through surveys, neighborhood meetings and committees (currently being gathered for input to the comprehensive plan updated for 2025).

Zoning & Development Standards

- Identifies existing federal and state regulations for wetland, floodplain, and Resource Protection Area and Resource Management Area (RPA/RMA) for Chesapeake Bay protection.
- Outlines required standards for new development and redevelopment based on use and zoning designation.

York County has adopted an ordinance that exceeds the minimum requirements of the NFIP. The ordinance designates the Flood Zone District as an Overlay District in County Code, §24.1. The community has 30 repetitive losses through the NFIP. Manufactured homes are not permitted in the floodplain, although there are some existing units in the floodplain. The ordinance outlines very specific hazardous materials/uses that are not permitted in the overlay district, including oil and oil products, radioactive materials, and specific poisons. The finished crown/centerline elevation of all new public or private streets must be at least 6½ feet above mean sea level (NGVD). The ordinance contains floodplain fill regulations that exceed minimum NFIP standards. Construction standards for structures in Zones A, AE and V reference the Virginia USBC and the requirements therein. The ordinance does not mandate additional freeboard for development; however, freeboard between one and a half feet and three feet above BFE is strongly recommended and the ordinance notes that a reduction of flood insurance premiums may result. Development in approximate A Zones requires that detailed hydrologic and hydraulic analyses be used to determine a BFE and 100-year floodplain boundary for the property. Flood hazard information is not currently noted on the Building Permit Application, but must be included on site plans submitted for review. Residential permit applicants must complete the *Preliminary Natural Resources Inventory* worksheet that includes indicators of the presence of regulatory wetlands.

The zoning and code enforcement staff within the Department of Environmental and Development Services regulate land use and development activities and elimination of property-related nuisances. The Zoning Section is responsible for zoning code enforcement and the elimination of property-related nuisances such as tall grass, weeds and junked cars. The Board of Zoning Appeals is responsible for reviewing and hearing appeals from decisions of County administrative officials concerning the zoning and subdivision ordinances; considering requests for variance relief from the requirements of these ordinances; and considering exceptions to the Chesapeake Bay Preservation Area Regulations. The department coordinates weekly staff-level reviews of site plans and proposed projects.

Stormwater Program
The York County Department of Environmental and Development Services review all new development in the County for compliance with state and county regulations. Offsite flow must be maintained at the same rate as before development if the downstream system is not adequate for increased flows. Installation of Best Management Practices (BMPs) such as wet ponds or lakes, and dry ponds, as well as other engineered systems are typically used.

In addition, when the County receives complaints/inquiries about drainage problems, the staff complete a study to determine if there are easements, and whether the County has responsibility to correct the problem. Staff makes recommendations for addressing the issue that may include developing a project plan and adding it to the Capital Improvement Plan list and ranking it with other projects in the schedule.

The County is working on drainage improvements for the Tabb Lakes outfall, Foxwood outfall, Moores Creek, which drains Woodlake, Running Man and properties in-between, Edgehill Drainage Study, and the Brandywine subdivision.

The County also has a Stormwater Advisory Committee (SAC) with the express goals of:

- Developing and implementing a public education and outreach program on stormwater issues,
- Increasing public involvement and participation in stormwater issues,
- Providing increased citizen access to County staff for stormwater and drainage issues, and
- Assisting County staff and the Board of Supervisors in identifying drainage problems and developing priorities for stormwater drainage projects.

The SAC has electronically posted and distributed copies of the committee's brochure, *A Homeowner's Guide to a Healthy Stormwater Drainage System*, and two important Fact Sheets entitled, *What You Can Do to Reduce Flooding in Your Area*, and *What You Can Do to Reduce Pollution In Your Area*. These documents are a means of educating the public about preventing flooding and maintaining drainage systems.

The Committee developed a presentation entitled *How to Reduce the Chance of Flooding* that is presented at HOA meetings and on the County's Community TV during hurricane season. The Committee also worked with the U.S. Army and U.S. Air Force, whose property borders York County, to ensure a coordinated approach to stormwater maintenance.

Public Education
Among the readily available public outreach mechanisms for York County, the website (http://www.yorkcounty.gov) provides residents with pertinent information, and answers numerous Frequently Asked Questions (FAQs). The County also posts most of its guiding documents, including the Comprehensive Plan on this site. The County publishes a quarterly

newsletter (CITIZEN NEWS), which is mailed to every household. The County maintains a government access TV channel using Cox Cable.

York County's Department of Fire and Life Safety provides a number of fire and life safety programs and maintains a stock of different types of educational materials available for residents, businesses, teachers, youth and adult groups. A Fire Prevention Educator provides child fire safety programs in the schools. The Department of Fire and Life Safety works with other County agencies and departments to sponsor *Safety Town*, a program for pre-school children in the summer to teach programs, such as fire safety, bike safety, electrical safety and disaster preparedness. The Department partners with the Sheriff's Office, York County Chamber of Commerce, the York-Poquoson American Red Cross and other County organizations to promote life safety and preparedness. The Department's Office of Emergency Management promotes disaster preparedness year-round through public programs (some mentioned above) and in the County quarterly newsletter to residents. In 2005, the Office of Emergency Management partnered with a local home improvement store to promote preparedness during the Christmas season. The Department's web site promotes emergency preparedness and life safety.

The Department of Environmental and Development Services Online Customer Service System provides a service for customers to submit service requests to the Department over the Internet. In addition to entering a service request, customers can follow the status and progress of their request online. Complaint/request categories include: drainage; garbage/recycling/yard debris; code enforcement; sewer; and mosquitoes. The department provides site plan review status information online.

Emergency Preparedness

The mission statement for York County's Department of Fire and Life Safety is to provide protection and safety to our community in order to prevent emergencies when possible, and to respond quickly, minimize pain, suffering and loss when emergencies do occur. The Department includes the Office of Emergency Management with the responsibility to minimize the effects of a significant emergency or disaster through the coordination of a comprehensive, risk-based program of mitigation, preparedness, response, and recovery.

A comprehensive update to the County's Emergency Operations Plan (EOP) was completed in 2003 by the Office of Emergency Management. The plan is maintained on the internal web site for County employees. The County has a regular full-scale exercise program that is part of the radiological emergency preparedness program and, because there are some basic functions regardless of the emergency, the lessons learned serve an all-hazard purpose. The Department is responsible for maintaining an Emergency Operations Center (EOC) with all the essential materials and supplies to sustain an emergency response.

The following provides an overview of the mitigation activities implemented by the County's Department of Fire and Life Safety:

Warning

Emergency Alert System (EAS) is a national civil emergency alert system that uses message relays between member radio and television stations to inform the public about immediate threats to national security, life, and property. EAS is now routinely used for severe weather warnings and can also be employed to disseminate Amber Alerts for missing children. The enhancement is an initiative of Governor Warner's Secure Virginia Panel designed to improve statewide preparedness, response, and recovery capabilities for emergencies and disasters. Governor Mark R. Warner announced June 5, 2004, that Virginia will enhance its public warning capabilities with a new satellite-based system that can rapidly transmit EAS messages throughout the Commonwealth.

York County coordinates with Newport News Waterworks and Williamsburg Water to provide door-to-door notification to property owners in the inundation zone for the agencies' dams located in York County.

The County recently made arrangements with a radio station in Gloucester (WXGM 99.1 FM) to broadcast emergency information for York County throughout a disaster and the recovery phase. Due to the large broadcasting area on the Peninsula and Southside, and widespread damage throughout Hampton Roads after Hurricane Isabel, the media became overwhelmed and summarized emergency information for the smaller media markets leaving out details residents needed for recovery activities.

Neighborhood Emergency Information Distribution System (NEIDS) – Extended power outages during the 1998 ice storm resulted in a large number of remote-area residents without access to current disaster-related information. The York County staff created NEIDS to relay pertinent information to homeowners' association leaders in remote areas, with the expectation that these persons could further distribute the information to residents. The system was further refined after Hurricane Isabel, and pre-disaster meetings with community leaders help ensure that the system maintains its effectiveness despite changes in personnel at the County or community level.

Evacuation

In addition to the information provided above regarding the state's Evacuation Plan, County planners note that storm surge zones located in the eastern part of the County are heavily developed with mostly single-family residential units. Evacuation of such a large number of people onto Route 17 and north across the Coleman Bridge through low-lying Gloucester County and on into Fredericksburg, while maintaining emergency vehicle access to all parts of the County, is challenging.

Special Needs Program

As part of the enhanced 9-1-1 system, York County maintains a database of addresses for special needs residents. Residents voluntarily register for this service through the Department of Fire and Life Safety. Dispatcher's notify first responders that they are responding to a residence that has a special needs resident and describes the type of special need. The database is geo-referenced, and dispatchers can sort for special needs residents in specific geographic areas of the County to notify or warn them of potential hazards or to check on them during disasters. The County maintains a separate database of manufactured home parks.

Community Emergency Response Teams (CERT)

York County Department of Fire and Life Safety established CERT with the emphasis on building neighborhood teams. The purpose is to have neighborhoods and areas of the County better prepared and self-sufficient when disaster strikes. Currently the County is working with several neighborhoods to develop neighborhood emergency response plans and provide CERT training. The County has a neighborhood recognition program for those neighborhoods that organize CERTs and develop an emergency plan.

Other Mitigation Activities

In 2000, York County received Hazard Mitigation Grant Program funding of $7,937 to install impact resistant glazing in windows for the Emergency Operations Center and associated offices.

Following Hurricane Isabel, the County rigidly enforced the substantial damage regulations in the floodplain management ordinance, and approximately 35 structures were required to be elevated or demolished and rebuilt. Structures that were uninhabitable after Hurricane Isabel were able to make application for tax relief with the County. Each case was considered individually.

As a result of significant damage from flooding during Hurricane Isabel, the Yorktown waterfront is being substantially redeveloped, including work that was completed in FY2003 for the Riverwalk Landing Project. The $27 million project, overseen by the County's Office of Economic Development opened in spring of 2005. The project features a mix of retail shops and office space anchored by a restaurant. There is also a new parking structure and two public piers for private and commercial vessels. A substantial portion of the waterfront was elevated with fill, approximately four feet above previous grades, bringing it above the 100-year flood elevation.

Household Chemical Disposal is a special program, offered by the Virginia Peninsulas Public Service Authority, which provides an opportunity for York County residents to dispose of a variety of household chemicals and paint products including: gasoline, insecticides, paint, brake fluid, herbicides, solvents and cleaners. Collections take place one Saturday morning every other month. This program helps remove aging hazardous chemicals from residences throughout York County, including areas that could be affected by flooding.

Backup generator power is available to most critical facilities, i.e. fire stations, emergency operations center, emergency communications center, and the County's computer network servers. Limited backup generator power is available at one school serving as a shelter to provide lights and some cafeteria services in shelter area. All sanitary sewer stations have emergency generators and three of the four well facilities also have backup power. The County continues to replace the external breather tubes on the vacuum sewer system that is susceptible to flooding. The areas of Dandy and Seaford were shut down due to flooding during Hurricane Floyd. Dandy replacements are complete and most of Seaford is already complete.

York County's adopted Capital Improvements Program (CIP) for Fiscal Years 2005-2010 includes the following storm water projects:

- Greensprings Drainage Improvements – Design and construction of piping system to restore the ravine and other recommended improvements due to increased drainage causing erosion in the ravines.
- Cook Road/Falcon Road Drainage Improvements – To correct and stabilize a low-lying area with inadequate outfall drainage system to prevent flooding.
- Edgehill/Fort Eustis Drainage Improvements – This outfall drains part of Edgehill and adjacent properties towards Fort Eustis Boulevard and the Poquoson River. The majority of improvements will involve improvements to the roadside drainage and major outfall system.
- EllaTaylor/Gray Lane Drainage Improvements – To correct drainage pattern which was reversed during construction of commercial property on Route 17.
- Rich Acres/Route 17 Drainage Improvements – To correct inadequate drainage system.
- Terrebonne Drainage – To correct inadequate drainage system.

The CIP also includes projects to provide or improve water service to existing areas of the county, which enhances fire protection. Those areas of the County include:

Old Quaker Estates	Queens
Skimino Farms	Nelson Park
Burcher Road	York Terrace
Carver Gardens	Old Taylor Road

The CIP includes an emergency shelter survey proposed for FY2007. This project would provide for an evaluation of schools and various County buildings and their suitability for emergency operations and shelter use with safety and sustainability as the significant concern during major wind events.

5.6 State, Regional, and Federal Capabilities

The section below presents State, Regional, and Federal mitigation capabilities that are common to all communities within the Peninsula planning area.

STATE CAPABILITES

Virginia Department of Emergency Management (VDEM)
VDEM's Strategic Plan 2004-2013
This plan recognizes and prepares for Virginia's changing demographics and increasing threats over the next ten-year period. Goals, strategies and resources are built around the mission statement, which is "to protect the lives and property of Virginia's citizens from emergencies and disasters by coordinating the state's emergency preparedness, mitigation, response, and recovery efforts."

Commonwealth of Virginia Emergency Operations Plan (State EOP), April 2004
This plan consists of a Disaster Recovery Plan, a Hazard Mitigation Plan, and five hazard-specific volumes. The mitigation goals and project prioritization criteria from Section 4 of Virginia's Hazard Mitigation Plan are:

- Goal 1 - Structural Mitigation Projects - Maintenance of critical communication, transportation, or supply chain management operations, beneficial impacts for multiple agencies/organizations, feasibility, cost and funding, and multi-hazard mitigation;
- Goal 2 - Policy, Planning and Funding Human health and safety, preparedness, economic recovery, multi-hazard mitigation, and health care and shelter;
- Goal 3 - Information and Data Development - Human health, safety or economic stability, multi-hazard mitigation, beneficial impacts for multiple agencies/organizations, feasibility, and information quality and security; and,
- Goal 4 - Education and Outreach Activities – Number of people and property affected, beneficial impacts for multiple agencies/organization, multi-hazard mitigation, transferability and adaptability, and simplicity and consistency.

Virginia Emergency Alert Systems (EAS) Stations
Specific AM/FM radio stations provide updated disaster and directional information to listeners in the Commonwealth. Thirty-seven radio stations cover fourteen regions in Virginia, including: Eastern Virginia (2 FM stations), Southside (one AM station, one FM station), and the Richmond extended area (two AM stations, two FM stations), which provide coverage for the Peninsula planning area.

Virginia Department of Transportation
The Virginia Department of Transportation Phase 1 and Phase 2 evacuation routes are shown below and discussed online at http://www.virginiadot.org/comtravel/hurricane-evac-hro.asp. They are also available in local telephone directories. Due to the large population and limited number of highways leading out of Hampton Roads, phased evacuation using assigned routes is necessary.

Phase 1 evacuees from Hampton, Poquoson, Virginia Beach, Norfolk, and York County should evacuate 24 to 14 hours prior to the onset of tropical storm force winds. Phase 2 evacuees from Newport News, the remainder of Hampton, Chesapeake, Portsmouth and Suffolk should evacuate 14 hours prior to the onset of tropical storm force winds. The evacuation zones are shown in Figure 5.0.

Figure 5.6-Evacuation Zones

The Peninsula's emergency management officials are re-examining the existing evacuation routes in conjunction with new storm surge mapping (produced by VDEM, FEMA and the U.S. Army Corps of Engineers), existing topography, floodplains, new mapping, new traffic patterns and new development.

Virginia Department of Conservation and Recreation (VDCR)

Chesapeake Bay Regulations

As part of Virginia's commitment to help preserve and restore the resources of the Chesapeake Bay, the Virginia General Assembly adopted the Chesapeake Bay Preservation Act in 1988. The Chesapeake Bay Preservation Area Designation and Management Regulations were adopted in 1990 and amended in December 2001. The revised regulations took effect in March 2002 and localities had until December 31, 2003 to revise local ordinances and become consistent with the new language.

The regulations require that communities east of Interstate 95, the "Tidewater" area of Virginia, regulate and enforce the use of Resource Protection Areas (RPAs) and Resource Management Areas (RMAs). The RPA is relevant to floodplain management because new development within the designated area must maintain a 100-foot buffer from the waterline of any perennial stream, as defined by the regulations. This includes all tidal water bodies in coastal areas. Both the Hampton Roads Planning District Commission and the VDCR provide technical assistance and guidance to communities in enforcing the regulations. In essence, this is a staff regulation that strengthens local floodplain manager ordinances by exceeding minimum NFIP standards.

Virginia Flood Damage Reduction Act

Virginia's General Assembly enacted the Virginia Flood Damage Reduction Act of 1989. The legislation was the result of several disastrous floods and coastal storms that impacted the state between 1969 and 1985. To improve Virginia's flood protection programs and place related programs in one agency, responsibility for coordination of all state floodplain programs was transferred in 1987 from the Water Control Board to VDCR. The agency was named manager of the state's floodplain program and designated coordinating agency of the NFIP under the act.

Virginia Dam Safety Act

The Virginia Soil and Water Conservation Board established the state's dam safety regulations as a result of the passage of the Virginia Dam Safety Act. The Dam Safety Program's purpose is to provide for safe design, construction, operation and maintenance of dams to protect public safety. The program enforces permit requirements related to the construction and alteration of impounding structures. All dams in Virginia are subject to the Dam Safety Act unless specifically excluded. Inundation mapping is required for all Class I and Class II dams in the Commonwealth. Dam Safety Program officials recommend mapping for all classified dams. Emergency Action Plans are required for all class I, II, and III dams.

Shoreline Erosion Advisory Service (SEAS)

DCR's Shoreline Erosion Advisory Service promotes environmentally acceptable shoreline and riverbank erosion control measures to protect private property and reduce sediment and nutrient loads to the Chesapeake Bay and other waters of the Commonwealth. In addition, the program promotes research for improved shoreline management techniques to protect and enhance Virginia's shoreline resources.

Since SEAS was created in 1980, DCR has provided technical advice about tidal shoreline erosion problems to more than 7,000 clients. They include landowners, local governments and environmental agencies. SEAS program activities also help local governments deal with sediment and nutrient loads from shoreline erosion and, of course, address the Commonwealth's obligation to reduce sediment and nutrient loads in the Chesapeake Bay and its tributaries. For example, following Hurricane Isabel, SEAS provided technical assistance to the residents of Hampton's Chesapeake Avenue to facilitate reconstruction of a seawall spanning numerous property owners. The complexity of the project permitting and the number of property owners involved required external assistance.

Virginia Marine Resources Commission (VMRC)

The Virginia Marine Resources Commission was established in 1875 as the Virginia Fish Commission. The Virginia Wetlands Act was passed in 1972 and placed under the management of VMRC, as was the 1980 Coastal Primary Sand Dune Protection Act. In 1982, the General Assembly broadened the 1972 Wetlands Act to include non-vegetated wetlands. The Habitat Management Division issues three types of Environmental Permits: subaqueous or bottomlands, tidal wetlands, and coastal primary sand dunes. The division's authority specifically regulates physical encroachment into these valuable resource areas.

The permit process relies on a single Virginia joint local/state/Federal permit application. The review process takes into account various local, state and Federal statutes governing the disturbance or alteration of environmental resources. The Marine Resources Commission plays a central role as an information clearinghouse for all three levels of review. Applications receive independent yet concurrent review by the community's Wetlands Board, the VMRC, the Virginia Department of Environmental Quality, and the U.S. Army Corps of Engineers.

Department of Housing and Community Development
The Commonwealth of Virginia is responsible for enacting the Virginia Uniform Statewide Building Code (VUSBC), and each county or city is responsible for enforcing the code locally. As of the first quarter of 2005, the VUSBC is based on the 2000 International Building Code, International Plumbing Code, International Mechanical Code, and International Fire Protection Code, and the 1999 National Electrical Code. The 2003 version of the IBC has been incorporated into the VUSBC, and is expected to go into effect Fall, 2005. The code contains the building regulations that must be complied with when constructing a new building or structure or an addition to an existing building, maintaining or repairing an existing building, or renovating or changing the use of a building or structure.

Enforcement of the VUSBC is the responsibility of the local government's building inspections department. All Peninsula communities charge fees to defray the costs of enforcement and appeals arising from the application of the code. The VUSBC contains enforcement procedures that must be used by the enforcing agency.

As provided in the Uniform Statewide Building Code Law, Chapter 6 (36-97 et seq.) of Title 36 of the Code of Virginia, the USBC supersedes the building codes and regulations of the counties, municipalities and other political subdivisions and state agencies, related to any construction, reconstruction, alterations, conversion, repair or use of buildings and installation of equipment therein. The USBC does not supersede zoning ordinances or other land use controls that do not affect the manner of construction or materials to be used in the construction, alteration, or repair.

REGIONAL CAPABILITIES

The Hampton Roads Planning District Commission (HRPDC), one of 21 Planning District Commissions in the Commonwealth of Virginia, is a regional organization representing sixteen local governments, including Hampton, Newport News, Williamsburg, James City County and York County. Planning District Commissions are voluntary associations created in 1969 pursuant to the *Virginia Area Development Act* The purpose of planning district commissions, as set out in the Code of Virginia, Section 15.2-4207 is "…to encourage and facilitate local government cooperation and state-local cooperation in addressing on a regional basis problems of greater than local significance." The HRPDC serves as a resource of technical expertise to its member local governments. Specific programs affiliated with HRPDC include HR STORM/HR CLEAN, HREMC and REMTAC, which are described below.

HR STORM and HR CLEAN
Regional governments are developing and implementing stormwater management programs that include construction of best management practices (BMPs), system maintenance, water quality testing, enforcement of program standards and public education. Significant results and cost cuts are achieved through regional cooperation. These regional efforts are coordinated through HR

STORM, a coalition of local government staff members who share ideas and pool resources for targeted educational program efforts about stormwater management. In addition, the HRPDC facilitates monthly meetings of the Regional Stormwater Management Committee where program staff members from 14 localities in Hampton Roads coordinate efforts in water quality data gathering and pollutant loading studies. These data enable localities to better target future program dollars to improve management of stormwater quantity and quality. HR CLEAN is the recycling and litter prevention education program of the HRPDC.

Hampton Roads Emergency Management Committee (HREMC) - The objective of the HREMC is to promote the inter-jurisdictional and inter-agency coordination of emergency management issues and foster emergency preparedness in the Hampton Roads area, including the Peninsula communities. The purpose is to provide a working group for the exchange of information, experience and technology among Hampton Roads Emergency Management officials and individuals with responsibilities in emergency management. Participants include community officials, American Red Cross, military liaisons, State and Federal agency representatives, Verizon, Virginia Natural Gas and Dominion Power. Public information materials include *Is Your Family Prepared for Hurricanes*, a detailed family preparedness booklet focusing on Hampton Roads' procedures for evacuation and readiness.

Regional Emergency Management Technical Advisory Committee (REMTAC). This organizational, policy-making group is composed of HRPDC staff, Emergency Management staff in local communities, including the Peninsula, and VDEM staff. REMTAC works to enhance emergency management plans on a regional level. The HRPDC provides support to REMTAC and local jurisdictions on a variety of emergency management issues, including: hurricane evacuation planning; emergency shelter planning; debris management resource planning; disaster planning for populations with special needs and public education awareness and hurricane preparedness programs. REMTAC members have access to a secure online forum among registered participants, in addition to monthly meetings.

Surry Power Station Emergency Public Information – Surry Power Station, located on the James River aboutseven miles south of Williamsburg, can generate 1,625 megawatts of electric power from its two nuclear reactors. Surry is linked to the Dominion Virginia Power transmission portfolio servicing the Peninsula. Although the power station would not normally be included in natural hazard mitigation planning, the facility represents a noteworthy manmade hazard and area emergency management plans pay considerable attention to the siren warning system. Cities and counties in the Surry Power Station Planning Area include: James City County, York County, Newport News, Williamsburg, Isle of Wight County, and Surry County. The Peninsula communities exclude all other hazard siren systems to avoid confusion over multiple siren tones and signals in the region.

FEDERAL CAPABILITES

The National Flood Insurance Program (NFIP)
Established in 1968, the NFIP provides flood insurance in communities that agree to regulate new development in identified Special Flood Hazard Areas through the adoption and

enforcement of a minimum Flood Damage Prevention Ordinance. The program also requires, as a condition of every Federally-backed mortgage within an identified Special Flood Hazard Area, the purchase and maintenance of a flood insurance policy for the life of the loan.

The Coastal Barrier Resources Act (CoBRA)
Established in 1972, the CoBRA is environmental legislation administered by the U.S. Fish and Wildlife Service. The legislation provides for the identification and protection of Coastal Barrier Resources. The act further prohibits the availability of Federally-backed assistance within identified areas, including grants, loans, mortgages and Federal flood insurance. For the Peninsula communities, only the City of Hampton has areas designated as part of the Coastal Barrier Resource System (Units VA-60 and VA-60P).

Coastal Zone Management Act (CZMA)
Established in 1972, and amended by the Coastal Zone Protection Act of 1996, the CZMA defines a national interest in the effective management, beneficial use, protection and development of the coastal zone and identifies the urgent need to protect the natural system from these competing interests.

VDEQ oversees the Virginia Coastal Resources Management Program, established to protect and manage an area know as Virginia's "coastal zone." All five of the Peninsula communities are located in the coastal zone. The program has produced a large number of publications and assisted in the development of numerous projects to support their nine primary goals, available online at http://www.deq.virginia.gov/coastal/goals.html.

Examples of the program's accomplishments impacting the Peninsula include:

- Coastal Dune Resources Inventory - Virginia has coastal dune resources on about 48 miles of shoreline. An inventory, now underway by the Virginia Institute of Marine Science, is part of an ongoing Virginia Coastal Program effort to establish a better understanding of dune systems, including primary, secondary, coastal and riverine dunes, in coastal Virginia. The inventory includes where dunes are located, how they should be defined, and how they function in the natural environment. The goal is improved management to ensure that both the habitat and flood protection benefits derived from these naturally occurring and rare systems are maintained.
- Riparian Buffer Sign Program - The Virginia Coastal Program designed a riparian buffer sign to emphasize the importance of riparian buffer restoration in the coastal watershed. The sign, available to all groups and organizations planting buffers in Virginia's coastal zone, links buffer restoration sites throughout Tidewater Virginia, providing the public with a consistent message on the benefits of riparian buffers. At York River State Park, a new buffer, planted on a steep denuded slope, protects the park's marsh and the York River beyond.
- Statistical analysis of the impact of channelization activities and dams in Tidewater Virginia on instream and riparian habitat.

- Virginia Clean Marina Program (VCMP) - In 2001, marina operators, marine industry representatives and state officials launched the program, which is a voluntary initiative designed to educate and give technical support and special recognition to marinas that implement BMP's that go above and beyond regulatory requirements, minimizing potentially negative impacts on water quality and coastal resources. Clean Marinas on the Peninsula include: Hampton Public Piers, Old Point Comfort Marina at Fort Monroe; Salt Ponds Marina in Hampton, Two Rivers Yacht Club in Williamsburg; and Wormley Creek Marina in Yorktown.

- Wetland Educational Materials - The Virginia Institute of Marine Science, College of William and Mary, with Coastal Program funding, has developed legal and educational materials that are being used by all local wetlands boards. VIMS also produces a Wetlands Newsletter and holds regular workshops and seminars for board members, local governments and others interested in wetland management.

6.0 Mitigation Goals and Objectives

Sections 4.1 through 4.5 document the risks from and vulnerabilities to the natural hazards that threaten the Virginia Peninsula communities. Section 5.1 through 5.5 provides more detailed information describing vulnerability and capacity on a community-by-community basis. With this information the PHMPC could now begin to formulate mitigation planning goals. The intent of the Goal Setting process is to identify areas where improvements to existing capabilities can be made so that community vulnerability is reduced.

Before formulating the goals for this plan, the PHMPC first reviewed planning goals in general. Each PHMPC member was provided a written and graphic explanation of Goals and Objectives, the purpose they serve and how they are developed and written. Following this activity, each PHMPC member was provided with an alphabetized list of 14 sample goal statements. Some of these goals were from existing community plans, some were developed as a result of analyzing the Risk Assessment, and some were generic community planning goals, such as "Improve Public Safety Services."

The PHMPC participated in a discussion of the sample goal statements, and developed an understanding of the relationship of plan goals and objectives to the recommended actions that they would later be tasked to formulate. Following this discussion, each PHMPC member received three index cards and was asked to write what they felt would be the most appropriate goals for this plan --- one on each card --- using the possible goal statements as a guide.

PHMPC members were instructed that they could use, combine or revise the sample statements or develop entirely new goals. Team members then posted their cards to the meeting room wall, and the goal statements were placed into similar groups, combined, rewritten and agreed upon. Upon group review, some of the proposed goal statements were determined to be better suited as objectives or actual mitigation projects – and were set aside for later use.

Based upon the planning data review and the process described above, the PHMPC developed the final goal statements listed below. None of the final goal statements are the same as those provided on the alphabetized list. These goals and objectives (and occasional action item) provide direction for reducing future hazard-related losses for the Peninsula communities.

GOAL 1: Reduce impacts and losses from natural hazards

Objective 1.1: Strengthen community Emergency Management programs

- Maintain each community's all- hazards Emergency Operations Plan (EOP) to support and promote Public Safety
  - ✓ Establish and maintain ability to coordinate with the public in disasters
- Provide Disaster Recovery Training for employees and volunteers
- Initiate, coordinate and support Business Continuity/Contingency planning

- Achieve and maintain National Weather Service "Storm Ready" Certification
- Establish and maintain baseline information resource systems (GIS)

Objective 1.2: Minimize exposure of existing development from likely hazard impacts
- Protect at-risk critical facilities
- Implement and maintain existing hazard loss reduction programs
- Mitigate repetitive hazard-related losses

Objective 1.3: Minimize exposure of new development to likely hazard impacts
- Integrate Mitigation Planning into each community's Comprehensive Planning program
- Enforce/enhance floodplain and zoning regulations or limitations in vulnerable areas, as appropriate

Objective 1.4: Strengthen community Floodplain Management programs
- Coordinate and maintain local floodplain management ordinances with the Virginia Uniform Statewide Building Code
- Address repetitive flood losses
- Participate in the NFIP's Community Rating System, as appropriate

GOAL 2: Promote awareness of hazards and vulnerability among citizens, business, industry and government

Objective 2.1: Develop a seasonal multi-hazard public education campaign to be implemented annually
- Hurricanes and coastal storms, flooding, tornados, winter storms and wildfires
- Flood Insurance
  - ✓ Availability, Coverage, Floodplain Management, the "50 percent" rule (and impact of inflation, market versus assessed value, and ICC)
- Business Continuity/Contingency planning
- Self-help guidance

GOAL 3: Maximize use of available funding

Objective 3.1: Maintain FEMA Eligibility

Objective 3.2: Identify, analyze and establish Mitigation project cost share options

- Multi-Objective Opportunities
  - ✓ Public/Private Partnerships
  - ✓ Coordination with other community goals, programs and projects
    - Housing Transportation, Recreation, Stormwater Management
- Community contributions

  - ✓ Cash (grants, budgeted)
  - ✓ In-Kind
- Property Owner Contributions

6.1 Review of Mitigation Alternatives

In a separate PHMPC meeting, the Planning Team undertook a brainstorming session to generate a set of viable mitigation alternatives that would support the above goals. To begin this process, each PHMPC member was provided with the following list of categories of mitigation measures:

- Prevention,
- Property Protection,
- Structural Projects,
- Natural Resource Protection,
- Emergency Services, and
- Public Information.

The PHMPC members were also provided with lists of alternative multi-hazard mitigation actions for each of the above categories. Below is an example of the list the PHMPC examined for the category of Property Protection. A facilitated discussion then took place to examine, understand and analyze the alternatives. The complete listing of alternatives reviewed and discussed is included in Appendix G**.**

PROPERTY PROTECTION: Property protection measures are used to modify buildings subject to damage rather than to keep the hazard away. A community may find these to be inexpensive measures because often they are implemented by or cost-shared with property owners. Many of the measures do not affect the appearance or use of a building, which makes them particularly appropriate for historical sites and landmarks.

- ***Retrofitting/disaster proofing***
  - ***Floods***
    - Wet/Dry floodproofing (barriers, shields, backflow valves)
    - Relocation/Elevation
    - Acquisition
    - Retrofitting
  - ***High Winds/Tornados***
    - Safe Rooms
    - Securing roofs and foundations with fasteners and tie-downs
    - Strengthening garage doors and other large openings
  - ***Winter Storms***
    - Immediate snow/ice removal from roofs, tree limbs
    - "Living" snow fences
  - ***Geologic Hazards (landslides and earthquakes)***
    - Anchoring, bracing, shear walls
    - Dewatering sites, agricultural practices
  - ***Drought***
    - Improve water supply (transport/storage/conservation)
    - Remove moisture competitive plants (Tamarisk/Salt Cedar)
    - Water Restrictions/Water Saver Sprinklers/Appliances
    - Grazing on CRP lands (no overgrazing-see Noxious Weeds)
    - Create incentives to consolidate/connect water services
    - Recycled wastewater on golf courses
  - ***Wildfire, Grassfires***
    - Replacing building components with fireproof materials
      - Roofing, screening
    - Create "Defensible Space"
    - Installing spark arrestors
    - Fuels Modification
  - ***Noxious Weeds/Insects***
    - Mowing
    - Spraying
    - Replacement planting
    - Stop overgrazing
    - Introduce natural predators
- ***Insurance***

6.1.1 Using Criteria to Analyze and Select Mitigation Measures

The PHMPC participated in a second facilitated discussion that took place to examine and analyze the alternatives, using FEMA's recommended STAPLE/E decision-making criteria, in addition to STAPLE/E, Sustainable Disaster Recovery, Smart Growth principles, and "Others". This was done to determine why one recommended action might be more important, more effective, or more likely to be implemented than another (a complete list of criteria examined is included in Appendix H).

STAPLE/E Criteria Set

Social:	Does the measure treat people fairly? (different groups, different generations)
Technical:	Will it work? (Does it solve the problem? Is it feasible?)
Administrative:	Do you have the capacity to implement & manage project?
Political:	Who are the stakeholders? Did they get to participate? Is there public support? Is political leadership willing to support?
Legal:	Does your organization have the authority to implement? Is it legal? Are there liability implications?
Economic:	Is it cost-beneficial? Is there funding? Does it contribute to the local economy or economic development?
Environmental:	Does it comply with Environmental regulations?

The PHMPC listed all of the hazards posing a threat to the community and then generated their preferred set of mitigation measures per hazard, using the criteria to determine the most suitable proposals. The proposed actions were recorded on easel pads and then posted to the wall for review, comment, and fuller development of the recommendation.

6.1.2 Reaching Consensus by Prioritizing Mitigation Measures

After selecting the mitigation measures, the recommended actions were posted on the wall and all Committee members were provided with nine colored dots of which there were three each of blue, red, and yellow. Each color represents high, medium, or low priority with regard to importance, and each color was assigned a corresponding value:

Blue = 5 points
Red = 3 points
Yellow = 1 point

Committee members then voted for their preferred mitigation measures by placing their dots on the hazard specific recommendations. Team members were allowed to place as many of any or all colors on any one recommendation or to spread them among multiple mitigation actions. They were allowed to trade dots, or otherwise negotiate with any other team member, and were not required to use all of their dots if they so chose. This process provided both consensus and priority for the Committee recommendations. Throughout the process, each Committee member was reminded that there would be time to discuss and revise each idea further through the scheduled team review, public input, and process of developing three drafts of this plan before submittal for review and adoption.

The table below shows how the Committee prioritized the mitigation measures with "dot points".

Table 6.1.2a- Committee Voting Results on Mitigation Measures

Categories of Mitigation Measures	Hampton	Newport News	Williamsburg	York County	James City County
Community Rating System	20				
Address Repetitive Losses	12				
Shoreline Erosion Reduction	9				
Refurbish Existing Seawall	2				
Drainage Improvements/Maintenance	13	37		7	
Elevate Flood-Prone Structures	1	18			0
Generator Wiring of Critical Facilities	1	32		35	
Public Notification System	0		5		
Relocate Critical Facilities	3				
Evaluate Existing Floodplain Mgmt	29			10	10
Open Space Protection	1			16	
Stormwater Management	3		3	19	5
Training Employees & Students	11	33			
Public Information	3				
Hazard Information Pack for New Homebuyers	2				
BFE plus 2 feet	15	25		8	
Small Business Contingency Planning		8			3
Elevation Certificate availability		12			
Shelter Management		17		1	
Water Conservation Programs		14			2
Forest/Wildfire Management		11	6		
Anti-Gouging Ordinance		14			
Moratorium for Codes Compliance		2			
Strengthen Land Development Regulations				58	5
Improve Neighborhood Communication					5
Floodproofing Measures					1
Examine/promote Bldg Codes					10
Underground Utilities Program			1		

The list of recommended mitigation measures distributed across the Categories of Measures in the following way:

Table 6.1.2b- Mitigation Measures Prioritized

Categories of Mitigation Measures	Hampton	Newport News	Williamsburg	York County	James City County
Emergency Services	1	65	5	36	5
Property Protection	16	26	1	0	4
Prevention	44	37	0	76	25
Public Information	36	33	0	0	0
Structural Projects	18	37	3	26	5
Natural Resource Protection	10	25	6	16	2

6.1.3 Action Plan

The results of the planning process, the risk assessment, the mitigation strategy, and the hard work of the Committee are presented below. This action plan presents the prioritized recommendations for the Peninsula communities to pursue in order to lessen the vulnerability of people, property, infrastructure, and natural and cultural resources to future disaster losses.

6.2 The Mitigation Strategy

Within the Virginia Lower Peninsula Planning Area, five communities participated on the PHMPC and provided valuable data and insight into this plan. While different in their boundaries, form and function, each recognizes their role to prepare for disaster, respond to natural hazards and undertake mitigation initiatives. Each, however, is part of the larger regional community that must prepare for and respond to a similar set of hazards. Thus, there is a "mosaic" of partners and these relationships define the overall hazard mitigation planning strategy.

The PHMPC has developed the following four mitigation strategies:

- **ENFORCE** existing rules, regulations, policies and procedures already in existence. Communities can reduce future losses not only by pursuing new programs and projects, but also by more stringent attention to what's already "on the books",
- **EDUCATE** the public using the hazard information that the PHMPC has collected and analyzed through this planning process so that the community better understands what can happen where, and what they can do themselves to be better prepared. Also, publicize the "success stories" that are achieved through each community's ongoing efforts,
- **IMPLEMENT** this Mitigation Action Plan, and
- **MOM** - monitor Multi-Objective Management opportunities, so that funding opportunities may be shared and "packaged" and broad constituent support is gained.

6.3 Peninsula Mitigation Recommendations

In this section, the PHMPC offers proposed mitigation actions in the form of recommendations. The recommendations that follow are those that would have a beneficial impact upon the community referenced; the schedules and cost estimates are not binding and do not imply that the community must complete each action. These recommendations are made with the knowledge and consent of the entire PHMPC by virtue of the formal adoptions of this plan (Appendix I). Thus, each participating community has identifiable "projects" in this plan. Table 6.1.4 provides a summary of the goals and objectives addressed by each Action Item. Please note that each community has recommended actions that reinforce their commitment to ensuring ongoing compliance with NFIP requirements.

Table 6.3 - Categorizing Action Items by Goal and Objective

	Hampton	Newport News	Williamsburg	York County	James City County
Goal 1: Reduce impacts and losses from natural hazards					
1.1 – Strengthen community Emergency Management	1,2,5, 6,9,10	1,3,5,7, 8,9,11	1,2,4, 5, 8	4,8,9,10,11	8
1.2 – Minimize exposure of existing development	2,3,4,5, 6,7,8,12	3,4,5,6, 8,9,10, 12	3,4,1,6,7,8,9	1,2,3,4,6, 9,10,11,12,13	1,2
1.3 – Minimize exposure of new development	10,11	6,10	3,8	1,2,5,6,7	3,5
1.4 – Strengthen community Floodplain Management	1,2,8,9	2,4,6,11	6,9	1,2,5, 6,12,13	1,2,3,5
Goal 2: Promote awareness of hazards & vulnerability					
2.1 – Develop multi-hazard public awareness campaign	1,10	5,7, 8,10,11	2,3,5,7,8	8,9,10,11	4,6,7
Goal 3: Maximize use of available funding					
3.1 – Maintain FEMA eligibility		2,6		1,6,7	3
3.2 – Identify, analyze and establish cost-share options	2,3,5, 6,8,11	4,8,12	3,,8	4,10,12,13	1,7

6.3.1 Hampton Mitigation Recommendations

Recommended Action Item #1: Enroll Hampton in the Community Rating System (CRS). Prepare outreach materials to include: flood insurance availability; retrofitting existing structures; and hazards packet for new homeowners.

Issue/ Background: Hampton has numerous structures in the 100-year floodplain (11,491), a large number of NFIP policies (9,792), and a large number of repetitive losses (160). CRS provides a structured incentive program to address flood hazards by rewarding policyholders with premium discounts, enhancing public safety, reducing damage to property and public infrastructure, avoiding economic disruption and losses, reducing human suffering, and protecting the environment.

Other Alternatives Considered: No action with regard to the CRS and NFIP Public Outreach is expected to result in increasing losses, and rising NFIP total premiums paid. Public outreach without CRS participation may not be as effective at reducing flood risk because policyholders would not experience any premium savings.

Responsible Office: Office of Emergency Management and Floodplain Management.

Priority (H, M, L): High

Cost Estimate: Application submittal is free if completed by City staff. Additional hours required for annual reviews, and re-application every five years.

Cost Benefit: All of Hampton's 9,792 NFIP policyholders would benefit from the CRS premium savings, resulting in approximately $219,000 annual savings (5 percent annual savings for each individual policy) for a Class 9 rating. A Class 8 rating results in almost $440,000 annual savings.

Potential Funding: Existing budgets.

Schedule: Submit CRS application within 6 months of plan adoption.

Recommended Action Item #2: Prepare Repetitive Loss Plan

Issue/ Background: Prioritize actions to assist in the rebuild and protection of structures with Repetitive Flood Losses. Nationwide, 30 percent of all NFIP payouts go to approximately one percent of policy- holders. Handling these structures first so that they are less likely to have repeat damage during future flood events should provide long-term benefits to the homeowner, community, and the NFIP. Fewer claims should eventually result in better mapping, improved technical assistance, and lower premiums. Additionally, because reducing the number of repetitive losses is a priority, the availability of funding to support this activity is more prevalent.

As a subset to the activity, an analysis of the 15 post-firm Repetitive Loses should be developed to better understand and correct this unusual situation.

Other Alternatives Considered: If the City does not take any action to address the large number of repetitive flood losses, the losses can be expected to increase.

Hampton is considering joining the Community Rating System, and with greater than 10 repetitive losses, development of a Repetitive Loss Plan is mandatory.

Responsible Office: Codes Compliance and Floodplain Management.

Priority (H, M, L): High

Cost Estimate: Staff time

Cost Benefit: The cost of staff time to develop a repetitive loss plan will result in savings being achieved by property owners, the community, and NFIP through CRS.

Potential Funding: FMA, existing budgets.

Schedule: Immediately

Recommended Action Item #3: Elevate flood-prone homes

Issue/ Background: Reduce property damage from repetitive flooding by elevating homes in flood-prone areas of the city that meet criteria of the elevation program.

Other Alternatives Considered: Relocation of flood-prone structures was considered, but Hampton is relatively built-out and the floodplain area is extensive. The number of developable lots out of the flood hazard area is minimal. Acquisition has been implemented in some cases, depending on condition of the structure, floor risk, and homeowner needs.

Responsible Office: Codes Compliance, Procurement, Public Works, Floodplain Management.

Priority (H, M, L): High

Cost Estimate: $40,000 - $60,000 per home

Cost Benefit: Average annual damages are substantially reduced when structures are elevated one foot above the Base Flood Elevation.

Potential Funding: HMGP, PDM, FMA, CDBG, USACE, and Virginia Department of Housing and Community Development Disaster Recovery Fund.

Schedule: A project to elevate approximately 21 homes has been approved by FEMA and implementation will begin in 2005. Elevation of flood-prone homes will be an ongoing strategy for the City.

Recommended Action Item #4: Relocation of Hampton City Schools Maintenance Facility out of repetitive flood area.

Issue/ Background: Relocate city schools maintenance operations to a facility outside 100-year floodplain. Facility is repetitively flooded and flooding damages important maintenance equipment.

Other Alternatives Considered: Elevation of the facility is not an option due to the size, the equipment needing to be housed, and the nature of the flood hazard. No action does not solve the flood problem.

Responsible Office: Office of Emergency Management, Hampton City Schools, NFIP Administrator

Priority (H, M, L): High

Cost Estimate: $300,000

Cost Benefit: Relocation would reduce average annual damages to the facility and equipment. Reduce labor and insurance costs, as well.

Potential Funding: HMGP, PDM, FMA, USACE, Tidewater, Soil Conservation Service Urban Programs or Floodplain programs, existing City and School Board capital improvement funds

Schedule: HMGP application submitted to FEMA in 2003. Grant denied. Future funding opportunities will determine schedule to complete this item.

Recommended Action Item #5: Develop storm-resistant beach along Hampton waterfront from Grandview to Fort Monroe. Integrate beach profile with existing hard structures.

Issue/ Background: Reduce beach erosion and property damage from storms affecting the Chesapeake Bay and waterfront in Hampton.

Other Alternatives Considered: No action will result in continued property damage from storms. Coastal armoring, such as seawalls, groins and jetties already exist in the area; additional hard structures can transfer problems to adjacent areas.

Responsible Office: Floodplain Management, Office of Emergency Management

Priority (H, M, L): High

Cost Estimate: $3,500,000

Cost Benefit: Study and develop "engineered" beach the length of Hampton's Chesapeake Bay waterfront to tie in existing areas of beach projects with new project to reduce the impact of storms on waterfront areas. Salt Ponds, Buckroe and Grandview neighborhoods would benefit. Reduced damage to roads and other infrastructure result in safer and quicker evacuation and emergency response, and faster return to normalcy after a storm event.

Potential Funding: HMGP, USACE, HRPDC Coastal Resources Technical Assistance Program, Tidewater Soil Conservation Service, existing city capital improvement funds.

Schedule: HMGP application submitted to FEMA in 2003. Grant denied. Future funding opportunities will determine schedule to complete this item.

Recommended Action Item #6: Public Notification/Warning System

Issue/ Background: Provide public notification of threats, hazards and emergency information. Allows remote hazard identification. Implementation will necessitate public education component and extensive staff training.

Other Alternatives Considered: No action alternative considered; homeowners would be provided only limited information as in the past.

Responsible Office: Office of Emergency Management

Priority (H, M, L): High

Cost Estimate: $100,000

Cost Benefit: Procure, install and maintain public notification system. Provide time for residents to prepare for storms, evacuate lower floors, and reduce damage from storm events.

Potential Funding: HMPG, FMA, DHS grants, USACE

Schedule: HMGP application submitted to FEMA in 2003. Grant denied. Future funding opportunities will determine schedule to complete this item.

Recommended Action Item #7: Wiring of critical facilities for generator quick hookup.

Issue/ Background: Wire existing shelters and critical facilities to use generator power in the event of power outages during emergencies. Currently, shelters without power are not climate controlled and food spoilage is problematic. Approximately 20 facilities and pump stations will be pre-wired for generator power.

Responsible Office: Office of Emergency Management, Hampton City Schools

Priority (H, M, L): High

Cost Estimate: $25,000 per facility, total $500,000

Cost Benefit: Providing ability to contract for and install backup generator power to shelters during emergencies decreases direct damages incurred by the School Division due to food spoilage, and decreases shelter management costs by allowing onsite food preparation.

Potential Funding: HMGP, VDEM, post-disaster Virginia Fire Programs Emergency Fund loans, existing capital budgets, other grant opportunities.

Schedule: HMGP Application submitted to FEMA in 2003. Grant denied. Future funding opportunities will determine schedule to complete this item.

Recommended Action Item #8: Re-evaluate existing regulations/programs with regard to strengthening overall approach to floodplain management.

Issue/ Background: Hampton's current floodplain management ordinance is a model ordinance, adopted at the recommendation of the Virginia Department of Conservation and Recreation. It meets, but does not exceed, the FEMA minimum requirements. City officials should consider measures that exceed NFIP minimums to help reduce flooding risk to new development, and examine overall program of recordkeeping and ordinance enforcement to ensure ongoing compliance with NFIP requirements. The City should consider the following changes to ordinance and development procedures: 1) Adopt two feet freeboard requirement above BFE for A Zones and V Zones (BFE + 2 feet); 2) Include Emergency Management comments in site plan review process; 3) Streamline process for collecting and maintaining Elevation Certificates for new and substantially improved structures in the 100-year floodplain (NFIP requirement); 4) Review all handouts, forms, and checklists provided to developers for site plan review and building permits to ensure consideration of flood hazards; and 5) Develop standardized form for making substantial damage determinations. The City should incorporate floodplain and emergency management into early project and site plan review. Two feet freeboard would provide better protection for structures, flood insurance premium savings, and points under the Community Rating System.

Responsible Office: Codes Compliance, Planning, Emergency Management

Priority (H, M, L): High

Cost Estimate: Minimal staff time to educate Council members and the public. There is a cost to builders to elevate structures an additional two feet and thus, a likely "pass-on" cost to prospective purchasers of those structures. Additional Emergency Management staff time required for review and comment on site plans.

Cost Benefit: Measures that exceed NFIP minimums help reduce flood insurance premiums, and protect structures from floods that exceed the 100-year flood. New development in the floodplain has lower average annual damages if elevated above BFE. Points from CRS also would provide additional savings to policyholders.

Potential Funding: HRPDC Coastal Resources Technical Assistance Program, Virginia Department of Conservation and Recreation Floodplain Management staff assistance, existing budgets.

Schedule: Within one year of plan adoption.

Recommended Action Item #9: Provide training and public education materials to school personnel and school children regarding characteristics of local hazards, mitigative actions, and emergency response.

Issue/ Background: Extensive storm surge area in Hampton exposes a large proportion of the population to flood hazards, whether at school, work or home. The City needs volunteers to help manage post-disaster scenarios, including tasks such as reporting post-event conditions to the EOC, serving as a means of communication throughout the neighborhoods, and traffic control.

Other Alternatives Considered: The No Action scenario does not increase awareness or provide volunteer workforce in post-disaster situation. Out of town contract labor after disasters is expensive and slower to respond than volunteers.

Responsible Office: Office of Emergency Management

Priority (H, M, L): Medium

Cost Estimate: $50,000

Cost Benefit: School personnel and school children learn disaster preparedness techniques, thereby minimizing evacuation times and protecting life and safety. Volunteer workforce can quickly respond to disasters and reduce additional post-disaster damage and injuries.

Potential Funding: Chesapeake Bay Restoration Fund (for conservation/restoration related educational aspects), HRPDC Coastal Resources Technical Assistance Program, VDEM, existing budgets

Schedule: Within two years of plan adoption.

Recommended Action Item #10: Preserve open space through floodplain park development.

Issue/ Background: Hampton has a citywide history of flooding. Strategic Investment Area Master Plans have identified particular parcels as suitable for parks or recreation areas. Limited acquisition of structures may be necessary to facilitate open space preservation of suitable flood-prone lands as recreation or park areas.

Other Alternatives Considered: No action to preserve or create open space in the floodplain may result in residential or commercial development of these sensitive areas.

Responsible Office: City Parks and Recreation, City Planning Department

Priority (H, M, L): Medium

Cost Estimate: $1,200,000

Cost Benefit: Parks and recreation planning in conjunction with floodplain management satisfies multi-purpose goals. Flooding of both existing and proposed developments is mitigated. CRS points available for this activity.

Potential Funding: Chesapeake Bay Restoration Fund, City of Hampton Redevelopment Funds, Virginia Land Conservation Foundation, Virginia Outdoors Fund Grant Program, Virginia Recreational Trails Fund Program, HMGP, PDM, FMA, CDBG

Schedule: Within three years of plan adoption. Zoning designations and Comprehensive Plan elements could be implemented faster at no cost in order to provide the framework for future projects and priorities.

Recommended Action Item #11: Implement Drainage Improvement Projects to protect against blockage.

Issue/ Background: Many culverts in the city are inadequately sized for increased runoff resulting from recent development.

Other Alternatives Considered: No action will result in continued urban and nuisance flooding, and possibly repetitive flood losses. Channel modification, while seemingly sufficient, does little to alleviate flood flows in the region.

Responsible Office: Department of Public Works, Engineering Services

Priority (H, M, L): Low

Cost Estimate: $75,000 per year

Cost Benefit: By maintaining culverts and protecting against blockages, flood flows are attenuated more quickly and nuisance flooding reduced. Average annual damages to structures and infrastructure are also reduced.

Potential Funding: Capital Improvement Plan, Tidewater Soil Conservation Service

Schedule: Within five years of plan adoption.

6.3.2 Newport News Mitigation Recommendations

Recommended Action Item #1: Adopt ordinance to prevent price gouging after a disaster.

Issue/ Background: After Hurricane Isabel, various vendors and contractors doubled and tripled their standard service prices.

Other Alternatives Considered: No action will allow price gouging to continue. Public education regarding contractor requirements/credentials considered, but statutory changes deemed most effective.

Responsible Office: Codes Compliance, Intergovernmental/Community Relations

Priority (H, M, L): High

Cost Estimate: Minimal cost; staff time only.

Cost Benefit: Property owners save money and can reinvest those funds into protecting property from future damage.

Potential Funding: Existing budgets.

Schedule: Immediately.

Recommended Action Item #2: Increase accessibility to digital Elevation Certificate data.

Issue/ Background: Currently, Elevation Certificate data are collected and entered into the city's computer system, but the data cannot be retrieved. The City is committed to ensuring ongoing compliance with NFIP requirements.

Other Alternatives Considered: Paper copies are bulky and do not last as long as digital data. No Action would result in continued problems accessing data for other floodplain management purposes.

Responsible Office: Plans Examiner, Codes Compliance, Information Technology, Department of Engineering

Priority (H, M, L): High

Cost Estimate: Minimal cost for staff time to reconfigure database access.

Cost Benefit: Sharing of this data will increase opportunities for mitigation projects, and provide emergency and land us planners with a useful floodplain management tool at minimal cost. CRS points available for this activity.

Potential Funding: Existing budgets

Schedule: Immediately

Recommended Action Item #3: Retrofit primary shelters, which are certified by the American Red Cross, with generator hookups.

Issue/ Background: Public schools in Newport News do not have generator power outside of emergency lighting. During storm events, this has been a concern especially when special populations are concerned. The City had to rent hotel rooms for special populations during Hurricane Floyd. During Hurricane Isabel, the shelters were left without power.

Other Alternatives Considered: No action alternative does not address the problem. Building new schools with full capacity generators is not financially feasible. Simply not opening shelters and forcing evacuation is not an option for the isolated Peninsula area.

Responsible Office: Office of Emergency Management, Department of Engineering and American Red Cross

Priority (H, M, L): High

Cost Estimate: $750,000

Cost Benefit: Special populations can be accommodated at shelters, rather than hotels, and shelters will be better equipped to feed and house all City residents.

Potential Funding: FEMA Hazard Mitigation Grant Program funds 75 percent and City funds 25 percent; PDM; Homeland Security

Schedule: Implementation during 2006.

Recommended Action Item #4: Continued implementation of Flood Assistance Program (FAP), primarily through flood-prone structure acquisition.

Issue/ Background: In response to continued requests for solutions to the persistent flooding of properties in its low-lying areas, the City of Newport News established a voluntary Flood Assistance Program in 1999. The program was designed to aid property owners with structures located in the 100-year floodplain. The goals of the FAP are to reduce or eliminate flood-associated losses, reduce flood insurance costs, and restore wetlands and greenspace. Acquisition of homes is a priority. Future plans for acquired areas include park uses in the regulatory floodway.

Other Alternatives Considered: Other options explored by the City included floodwalls and levees. The expense of installation and regular maintenance, plus the previous flood damage to many area homes, made these options less feasible than an assistance program. The City determined the appropriate solution involved returning the properties to wetlands and greenspace.

Responsible Office: Department of Engineering

Priority (H, M, L): High

Cost Estimate: $200,000 annual City funding, plus any grant funding that may become available. Program can be expanded based on available funds.

Cost Benefit: For areas prone to repeated flooding, acquisition of homes offers a permanent solution. The families, who have endured repetitive flooding, are given a new start and are forever removed from flood harm. Also, local emergency management crews are no longer required to rescue these residents during dangerous storm or flood events. CRS points available for this activity.

Potential Funding: Annual allocation from the Stormwater Fund Balance. Program costs include fees associated with appraisal/inspection, legal/closing, replacement housing, moving, property security and demolition. Additional funding through HMGP, PDM and FMA will be used, as available.

Schedule: Ongoing. The program includes a 60-day application period each year. A Flood Assistance Program Committee then convenes to review ranked, eligible properties. The Committee makes the final decision for the use of fiscal year funding each year. To date, about thirty homes have been acquired through the FAP.

Recommended Action Item #5: Continue forest management program to mitigate wildfire hazards and promote health of forests within the City's reservoir watersheds.

Issue/ Background: The Newport News Department of Public Utilities (Waterworks) has maintained a comprehensive forest management program for over 20 years. The program includes fire trails, clear-cutting, thinning, disease control and other elements to maintain healthy forests. The program works in conjunction with a Newport News Watershed Protection ordinance.

Other Alternatives Considered: Funding could be increased to the program to provide additional staff for program enhancements. Some aspects of the program could be contracted to outside sources. At the present time, these alternatives were rejected in favor of maintaining the program's status quo as the program has been effective.

Responsible Office: Newport News Waterworks, Chief of Forest Resources

Priority (H, M, L): High

Cost Estimate: Estimated $1,000,000, annually.

Cost Benefit: The forest program's main objective is water quality protection, and it helps maintain the quality of the City's existing raw water sources.

Potential Funding: City's Annual Operating Budget, US Forest Service, Virginia Department of Forestry

Schedule: Ongoing.

Recommended Action Item #6: Review floodplain management ordinance and enact new requirements based on local conditions. Adopt an ordinance requirement for floodplain structure elevation to Base Flood Elevation plus two feet, and enact a cumulative substantial improvement rule.

Issue/ Background: Currently, the City's floodplain management ordinance requires a freeboard of one foot above BFE. By adding an additional foot, structures will be protected from floods that exceed the 100-year flood, and insurance premiums will be further reduced. Property owners aware of the current substantial improvement requirements may circumvent the rule by making piecemeal improvements to the structure to avoid triggering the elevation requirements. The City is committed to ensuring ongoing compliance with NFIP requirements.

Other Alternatives Considered: No Action would result in continued enforcement of the one-foot freeboard, which does not provide property owners with maximum flood insurance premium discount.

Responsible Office: Codes Compliance and Planning, Department of Engineering and City Attorney

Priority (H, M, L): Medium

Cost Estimate: Staff Time.

Cost Benefit: By expending building costs for an additional course of block on new and substantially improved construction (approximately $1,500), homeowners will realize significant reduction in flood insurance premiums, and a reduction in average annual damages. The cumulative substantial improvement rule would help ensure that the value of flood-prone structures is not continually increased without being protected from flooding. Freeboard above the BFE reduces the chance of flooding based on mapping inaccuracies, floods that exceed the base flood, and damage from floating debris. CRS points are available for these activities.

Potential Funding: Existing budgets.

Schedule: Within one year of plan adoption.

Recommended Action Item #7: Develop Natural Hazards Curriculum for Public Schools

Issue/ Background: Schools have plans in place to direct student actions when natural hazards occur. Lessons targeted to grade level and seasons should be developed to accompany the emergency plans and inform students about the characteristics of natural hazards that may affect the region.

Other Alternatives Considered: No Action would result in a student body with knowledge of response actions, but little knowledge of the hazards directly. Another alternative considered included sending hazard information packets to parents, but again, the student body would not gain the necessary background on hazards desired.

Responsible Office: Newport News City Schools, Asst. Superintendent for Business, Emergency Management

Priority (H, M, L): Medium

Cost Estimate: $25,000

Cost Benefit: Parents will learn hazards information from their children, and children will be better informed, and therefore, better prepared for disasters. Many materials and curriculums are currently available.

Potential Funding: Community and civic groups, the Virginia Department of Education, the Virginia Department of Emergency Management, FEMA, and NOAA are potential sources of funding and materials.

Schedule: Within two years of plan adoption.

Recommended Action Item #8: Provide contingency planning assistance to small businesses.

Issue/ Background: In the lead-up and aftermath of Hurricane Isabel in 2003, necessary supplies were limited and small businesses that were not prepared had substantial business interruptions or, in some cases, failures. Damage from the storm's effects exacerbated the lack of planning and compounded the economic effects. FEMA acknowledges that small- to medium-sized businesses provide nearly 80 percent of the jobs in an average community, but are at great risk for failure after a disaster; 30 to 40 percent never reopen.

Other Alternatives Considered: Taking no action would not alleviate the financial effects on small business from another disaster. Outreach to large businesses was also considered; however, large franchised retailers and other ventures with corporate backing are more resilient than small businesses.

Responsible Office: Purchasing and Development

Priority (H, M, L): Medium

Cost Estimate: $50,000, to include city staff time and outreach materials.

Cost Benefit: Advance planning and mitigation can significantly increase the likelihood that small businesses can survive a disaster, keeping a community economically viable and helping to fuel the recovery.

Potential Funding: SBA, Economic Development Administration, and FEMA for materials, City's annual operating budget for staff time, and development of an assistance program with outreach. The Association of Contingency Planners, Old Dominion Chapter, should be contacted to determine their level of interest and possible involvement. Their help in training business leaders could reduce costs significantly.

Schedule: Within one year of plan adoption.

Recommended Action Item #9: Upgrade drainage system maintenance and increase maintenance frequency of stormwater drainage system.

Issue/ Background: Cleaning of the City's stormwater system was started in 1985 and expanded in the late 1990s, but inadequate funding has prevented annual cleaning of the entire system, which has resulted in flooding problems. Presently, City crews visit hot spots during intense rain storms resulting in extra man power and additional hours.

Other Alternatives Considered: Enacting an ordinance to require homeowners to clean adjacent ditches was considered and rejected. No action alternative also considered, but status quo is unsatisfactory. Recent significant staff and equipment upgrades will assist in increased maintenance, but additional targeted funding may continue to be necessary.

Responsible Office: Department of Public Works, City Manager's Office

Priority (H, M, L): Medium

Cost Estimate: $250,000 annually.

Cost Benefit: Overall maintenance of the stormwater system will remove blockages and decrease the potential for nuisance, urban flooding which primarily affects public infrastructure.

Potential Funding: Increase the Stormwater Fee by an appropriate percentage per month.

Schedule: Within three years of plan adoption.

Recommended Action Item #10: Implement flood hazard awareness program to: 1) inform existing property owners of their flood zone designation and flood insurance availability; 2) inform property owners and surveyors of FEMA's map amendment process; and 3) incorporate flood hazard awareness into Site Plan and Building Permit processes.

Issues/Background: Many property owners are not aware that, in conjunction with a local surveyor, they can more accurately ascertain the boundaries of the Special Flood Hazard Area depicted on the Flood Insurance Rate Maps (FIRM). The FEMA map amendment process can then be used to officially modify the FIRM if existing topography does not match FIRM boundaries. Accurately completed Elevation Certificates also benefit property owners by more precisely describing the pertinent site elevation data. Such a flood hazard awareness program is a creditable activity under CRS. Engineering and Codes Compliance have begun discussions about integrating the building permit application and approval processes with the City GIS, allowing for linkages to floodplain maps, full Elevation Certificates, and other awareness materials.

Responsible Office: Virginia Department of Conservation and Recreation, Virginia Association of Surveyors, Codes Compliance, Engineering, Public Works and Emergency Management.

Priority (H, M, L): Medium

Cost Benefit: Property owners would obtain more accurate flood zone determinations in the long run, which could reduce insurance premiums or increase flood insurance coverage, depending on the risk. Knowledge of flood hazards early in the building process reduces the likelihood of compliance issues.

Potential Funding: Existing budgets

Schedule: Implementation within two years of plan adoption

Recommended Action #11: Enroll Newport News in the Community Rating System (CRS). Prepare outreach materials to include: flood insurance availability; retrofitting existing structures; and hazard packets for new homeowners. Also prepare Repetitive Loss Plan as mandated.

Issue/Background: Newport News has numerous structures in the 100-year floodplain (5,250), a small number of NFIP policies (1,655; 32%) and a moderate number of repetitive losses (20). CRS provides a structured incentive program for multiple city agencies to address flood hazards by rewarding policyholders with premium discounts, enhancing public safety, reducing damage to property and public infrastructure, avoiding economic disruption and losses, reducing human suffering and protecting the environment.

Other Alternatives Considered: No action with regard to the CRS and NFIP Public Outreach is expected to result in increasing losses, and rising NFIP total premiums paid. Public outreach without CRS participation may not be as effective at reducing flood risk because policyholders and city policymakers may not experience such a notable premium savings.

Responsible Office: Department of Engineering, and Office of Emergency Management

Priority (H, M, L): Medium

Cost Estimate: Application submittal is free if completed by City Staff. Additional hours required for annual reviews and re-application every 5 years.

Cost Benefit: All of Newport News' 1,655 policyholders would benefit from the CRS premium savings, resulting in approximately $31,680 savings (5 percent savings for each individual policy) for a Class 9 rating. A Class 8 rating results in almost $64,000 savings.

Potential Funding: Existing Budgets

Schedule: Submit CRS application within one to two years of plan adoption

Recommended Action Item #12: Conduct engineering feasibility study of flood-proofing alternatives for four flood-prone pumping stations, and pursue available funding for cost-effective solutions. Elevate these pumping stations out of the floodplain to reduce future loss and damages and to virtually eliminate risk associated with wastewater for over four-thousand residents.

Issue/Background: In both Hurricane Floyd (1999) and Hurricane Isabel (2003), four pump stations within the 100-year floodplain were damaged by storm surge. Flooded stations are unable to pump water out of the neighborhoods and put nearly fifteen-hundred homes at risk for safety and sanitation reasons. The flooding is also taxing on work crews due to overtime hours spent keeping the system working and maintained. Emergency crews are put in danger when rescuing citizens affected by the flooding and unhealthy/unsafe sanitary conditions.

Other Alternatives Considered: If no action is taken the pump stations will continue to flood during hurricanes, strong rainstorms and nor'easters. Thousands of dollars in supplies and over-time labor will continue to accrue. Each time a pump station floods, roads are blocked and homes are flooded, leaving citizens in the service area vulnerable to unhealthy and unsafe sewage conditions. No action would continue to render the pump stations useless during flood conditions. Relocating the pump stations out of the floodplain is not a cost-effective option as significant portions of the service areas are also flood-prone.

Responsible Office: Public Works Wastewater Division and Engineering Stormwater Division

Priority (H, M, L): High

Cost Estimate: $2.4 million

Cost Benefit: Project will reduce the cost of overtime services, minimize the public health danger associated with the spillage of raw sewage, and reduce the need for voluntary citizen clean up after pump stations flood. Emergency service costs and hazards to employees will also be reduced during flood events.

Potential Funding: PDM, HMGP, City Budget

Schedule: Once plans are finalized, the elevations should take two years to complete. Each of the four pump stations are scheduled to be elevated within five years of plan adoption.

6.3.3 Williamsburg Mitigation Recommendations

Recommended Action Item #1: Implement Alert Warning System

Issue/ Background: The current alert system involving NOAA weather radio alerts is unreliable because radios can be unplugged or out of batteries, or antennas may not work. An LED read out in all government and critical facilities, including schools, will improve communications and allow instant relay of important information.

Other Alternatives Considered: The No Action alternative continues to rely on NOAA radio, which is unreliable in emergencies. Dispatching emergency personnel to critical facilities is time-consuming and involved risk to personnel. Telephoning critical facilities is also time-consuming and allows opportunities for human error or miscommunication.

Responsible Office: Fire Chief

Priority (H, M, L): High

Cost Estimate: $600/facility

Cost Benefit: The system improves communication in emergencies, thereby facilitating safe evacuation and potentially saving lives.

Potential Funding: Existing City budgets

Schedule: Within three years of plan adoption

Recommended Action Item #2: Achieve Storm Ready Certification from the National Weather Service

Issue/ Background: StormReady is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle severe weather. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations.

Other Alternatives Considered: Taking the actions necessary to achieve Storm Ready Certification without applying for the certification was considered, but rejected. The certification itself is an incentive to pursue changes.

Responsible Office: Emergency Management

Priority (H, M, L): High

Cost Estimate: Staff time

Cost Benefit: These efforts and planning activities would lead to long-standing changes in vulnerability and, depending upon status of current efforts and programs, can be initiated at very little cost.

Potential Funding: Existing budgets

Schedule: Within two years of plan adoption.

Recommended Action Item #3: Strengthen GIS digital mapping program for cadastral and hazard planning purposes. Continue process of adding data layers, improving hardware capabilities, and expanding software availability across City departments.

Issue/ Background: The City's land use/ownership, zoning, and hazard mapping were only available through hard copy files and traditional cartographic methods until about 2004. Through several grants and City funding, a GIS division within the Finance Department has been created. Strengthening the fledgling program is now the priority.

Other Alternatives Considered: The No Action alternative is unacceptable as traditional hard copy maps do not last as long, cannot be easily edited or updated, and are more vulnerable to loss or destruction.

Responsible Office: Finance Department

Priority (H, M, L): High

Cost Estimate: Staff time, (previously approved) $8,000 grant, plus hardware costs of approximately $6,000 annually.

Cost Benefit: The durability and usefulness of digital mapping information for hazard and land use planning is well documented. GIS can be used to reduce losses from natural hazards through: improved evacuation planning; floodplain information accessibility; disaster recovery; and pre-identification of mitigation opportunities. Map data can be shared within the community and with contractors, property owners and others interested in using Williamsburg's cadastral database.

Potential Funding: Homeland Security grant provided software, and Annual City Budget funds staff time, NOAA Coastal Service Center GIS Integration and Development program.

Schedule: Ongoing

Recommended Action Item #4: Evacuation Shelter Generator Upgrades

Issue/ Background: Previously, a shared evacuation shelter with James City County provided less-than-optimal conditions. A new shelter, dedicated to Williamsburg residents, and certified by the American Red Cross, will come online in the near future. Backup generator power for the new facility remains a necessity.

Other Alternatives Considered: Continued use of the shared facility did not adequately serve Williamsburg's residents. Without generator power at the new facility, the housing and feeding of evacuees is more difficult, and possibly dangerous.

Responsible Office: Emergency Management, American Red Cross

Priority (H, M, L): Medium

Cost Estimate: $25,000 per shelter

Cost Benefit: The new, improved evacuation shelter is more centrally located for Williamsburg residents, facilitating a faster and safer evacuation process.

Potential Funding: Existing budgets

Schedule: Ongoing, with generator hookups installed by 2007.

Recommended Action Item #5: Train CERT team members for personal pre-disaster planning and neighborhood response teams, and establish emergency communication system for same.

Issue/ Background: Pre-disaster preparation, whether installation of plywood window covers or ditch clean-out, helps reduce damage from natural disasters. Neighborhood response and communication in the aftermath of a disaster helps prevent compound damages, and protects life and safety. For neighborhoods without power or emergency access, the CERT team members can help relay important messages from City officials.

Other Alternatives Considered: CERT teams with willing volunteers are already established in Williamsburg. The same training provided to City officials is not as effective because they do not have the same neighborhood—level interaction with property owners.

Responsible Office: Emergency Management

Priority (H, M, L): Medium

Cost Estimate: $12,000 for materials and training over a two year period. $6,000 for equipment.

Cost Benefit: These actions will reduce pre- and post-disaster confusion, improve property owner protection levels, and reduce damages to structures and infrastructure. By helping property owners identify mitigation measures for their owner property, CERT members will foster better-prepared neighborhoods.

Potential Funding: HMGP, City operating budget, FEMA

Schedule: Within three years of plan adoption

Recommended Action Item #6: Continue programs and capital improvements to upgrade drainage system citywide, including Colonial Williamsburg.

Issue/ Background: Williamsburg's urban drainage system dates back almost 40 years, and the system requires routine maintenance and infrastructure improvements to accommodate existing and new development. Ongoing enhancements help alleviate urban flooding of intersections and low-lying areas. Colonial Williamsburg Foundation performs an annual storm drain maintenance program in the Historic Area, under the direction of the City of Williamsburg.

Other Alternatives Considered: Complete drainage system overhaul for Williamsburg and the Historic District would disrupt tourism and be extremely costly. No action with regard to drainage system improvements, while new development continues, could exacerbate current nuisance flooding.

Responsible Office: City of Williamsburg Public Works and Utilities, and Colonial Williamsburg Foundation

Priority (H, M, L): Medium

Cost Estimate: $25,000/year for Colonial Williamsburg Foundation. Variable annual costs for Williamsburg as dictated by annual Capital Improvement Program budget.

Cost Benefit: Reduction of nuisance flooding increases the life of infrastructure, while eliminating flooding of intersections eases the burden on public safety officials and facilitates citywide access to businesses and attractions despite inclement weather. Protection of valuable national historic resources in the Historic District is an important goal of the Colonial Williamsburg Foundation.

Potential Funding: City's Capital Improvement Program (funded by one percent sales tax receipts and other funds). Costs for projects in the Historic Area are shared with the Colonial Williamsburg Foundation.

Schedule: Within two years of plan adoption.

Recommended Action Item #7: Colonial Williamsburg Annual Tree Maintenance Program

Issue/ Background: Colonial Williamsburg has instituted an annual tree trimming program to minimize damage from wind and ice. Trees are systematically trimmed to open up and allow the trees to withstand sustained winds of 80-90 mph. Trees are a major cause of sustained power outages due to both strong winds and ice accumulation during winter storms. Large, older trees in the Historic District may also threaten vulnerable historic structures if felled by wind or ice.

Other Alternatives Considered: No action with regard to tree maintenance fails to protect historic resources from wind and ice, and could result in prolonged power outages.

Responsible Office: Colonial Williamsburg Foundation

Priority (H, M, L): Medium

Cost Estimate: $75,000/year

Cost Benefit: Expenditures to maintain storm-resistant trees results in lower average annual damages to historic structures and infrastructure from wind and ice storms.

Potential Funding: Existing budgets.

Schedule: Ongoing.

Recommended Action Item #8: Disaster-Resistant University (DRU) Planning for the College of William & Mary

Issue/ Background: Disasters can and do affect university and college campuses, and impose monetary losses and disruption of the institution's teaching, research, and public service. These losses can be substantially reduced or eliminated through pre-disaster planning and mitigation actions.

By assisting the College of William and Mary with disaster-resistant university planning, the City of Williamsburg further mitigates the need for costly emergency response and cleanup from hazard events. The university should prepare a Disaster-Resistant University Mitigation Plan that is coordinated across William and Mary's various departments, integrated into the University's existing plans, and prepared in conjunction with the City's planning goals.

University officials took part in the planning process for this Hazard Mitigation plan, and over the course of the planning process, became familiar with the general plan structure.

Other Alternatives Considered: No action

Responsible Office: Williamsburg Emergency Management; William & Mary Facilities Management officials

Priority (H, M, L): Medium

Cost Estimate: $35,000

Cost Benefit: A plan that effectively coordinates the various functions of the university and the city before, during and after a disaster would result in cost savings for both the university and the municipality.

Potential Funding: FEMA DRU funding; VDEM; City of Williamsburg

Schedule: Within 4 years of plan adoption.

Recommended Action Item #9: Request that the State NFIP Coordinator's Office at the Virginia Department of Conservation and Recreation review the City's floodplain management ordinance to ensure that Substantial Improvement/Substantial Damage language is up to date.

Issue/ Background: RPA and RMA zones adopted as part of the Chesapeake Bay Preservation Ordinance are 100 feet and 500 feet, respectively. The ordinance serves as the City's floodplain management ordinance, but may not adequately address new structure requirements and remodeling or alterations to nonconforming principal structures, utilities, railroads and other infrastructure. VaDCR floodplain managers can review the ordinance and recommend any necessary changes to remain compliant with NFIP minimum standards. The City is committed to ensuring ongoing compliance with NFIP requirements.

Other Alternatives Considered: No action may jeopardize the community's continued participation in the NFIP.

Responsible Office: Williamsburg Emergency Management; Williamsburg Department of Planning; VaDCR

Priority (H, M, L): Medium

Cost Estimate: Staff Time

Cost Benefit: Continued availability of flood insurance in the community as a result of continued compliance with NFIP ordinance requirements.

Potential Funding: Not applicable.

Schedule: Within 2 years of plan adoption.

6.3.4 James City County Mitigation Recommendations

Recommended Action Item #1: Continue flood-prone structure elevation project, focusing on Chickahominy Haven, and the county's seven repetitive losses.

Issue/ Background: Chickahominy Haven is a James City County neighborhood with 192 homes along the Chickahominy River. The neighborhood association is very active. As a result of Hurricane Isabel, flooding damaged numerous houses. Elevation of the most severely damaged, and repetitively flooded structures is a priority for the County. Five of the county's repetitive loss structures are in Chickahominy Haven.

Other Alternatives Considered: The floodplain of the Chickahominy River is wide, and relocating properties on the same parcel and out of the floodplain is rarely possible. Acquisition of home sites in this area was not desirable from the County's perspective due to maintenance requirements.

Responsible Office: Emergency Management and Planning

Priority (H, M, L): High

Cost Estimate: $154,000 for elevation of three homes; additional funding for at least two more repetitively flooded homes will be pursued.

Cost Benefit: Elevation of these structures is expected to protect contents and residents from the 100-year flood. Protecting repetitively flooded structures will result in savings being achieved by property owners, the community, and NFIP.

Potential Funding: FEMA HMGP Grant 75%, VDEM 20%, and 5% County in-kind services.

Schedule: Grant has been approved and the elevation projects are being bid to contractors.

Recommended Action Item #2: Conduct certified lowest floor elevation surveys of existing homes, manufactured homes and commercial structures in identified floodplains. Include County-wide housing needs assessment.

Issue/ Background: The County Comprehensive Plan, Housing Element Action 14, includes a recommendation for a County-wide assessment of housing conditions geared toward rehabilitating substandard housing and eliminating vacant or dilapidated structures. Performing simultaneous surveys to determine flood risk for existing structures will help prioritize structures based not only on structural condition, but also vulnerability to flood hazards. Further, identifying manufactured homes in the floodplain will aid County emergency managers in setting evacuation priorities for flood events. A database of lowest floor elevations may be creditable through CRS, and is an invaluable planning tool for prioritizing elevation and retrofit projects in the future.

Other Alternatives Considered: Surveying lowest floors as a separate project necessitates two visits to each structure. Doing the housing needs assessment without collecting elevation data provides an incomplete analysis with regard to potential damage, and will not be creditable under CRS.

Responsible Office: Development Management and Community Services

Priority (H, M, L): High

Cost Estimate: $150,000 (individual FEMA Elevation Certificates may cost as much as $250 each, depending on location and terrain. Cost savings may be realized if neighborhoods are surveyed at one time.)

Cost Benefit: A database of structural elevations in and near floodplains aids county planners in prioritizing structures that are most vulnerable to flood risk. If credit is granted through CRS, flood insurance policyholders may save additional money on premiums.

Potential Funding: HMGP, PDM, Virginia Department of Housing and Community Development Rehabilitation Grant programs, CDBG

Schedule: Implementation within two years of plan adoption.

Recommended Action Item #3: Revise site plan application, building permit application and accompanying checklists to include/require detailed information on the flood hazard, to include flood zone, map number and date, and Base Flood Elevation. Job Site cards should also have BFE indicated. Consider Emergency Management participation in development reviews to solicit input on natural hazards, ingress/egress, and other evacuation-related concerns.

Issue/ Background: All of the applications and checklists do not currently require this information. The County is committed to ensuring ongoing compliance with NFIP requirements.

Other Alternatives Considered: No action with regard to this activity could jeopardize participation in the NFIP and CRS. Revision of simply the Building Permit would satisfy NFIP requirements, but all such documents should be examined simultaneously to provide clear direction to builders and developers.

Responsible Office: Code Compliance

Priority (H, M, L): High

Cost Estimate: $500 for staff time and copying costs

Cost Benefit: Clear direction regarding implementation of the floodplain management ordinance and information about flood risk reduces compliance issues and results in structures that are at less risk of flood damage.

Potential Funding: Existing budgets.

Schedule: Immediately

Recommended Action Item #4: Implement the Comprehensive Plan element to "protect County shorelines from erosion through a coordinated, unified area approach that utilizes properly designed methods of vegetative or structural stabilization, bank regrading, beach nourishment and/or relocation of activities to less sensitive areas."

Issue/ Background: The County's Erosion and Sediment Control program adequately regulates land disturbance activities in accordance with State regulations. Missing is a program element to address existing shoreline problem areas that can exacerbate storm damage, and detrimentally affect water quality. A citizen advisory/assistance program for shoreline erosion, in conjunction with the knowledgeable professionals of Virginia Department of Conservation and Recreation's Shoreline Erosion Advisory Service would address this deficiency.

Other Alternatives Considered: Regulating new development projects, while overlooking shoreline problem areas on private property, does not adequately address erosion problems. Having a free assistance program in place to intercept and help property owners before they have to take drastic action or before they take action without a permit benefits both the County and property owners.

Responsible Office: County Development Management, Virginia DCR

Priority (H, M, L): Medium

Cost Estimate: $10,000 for public outreach and staff time to support project identification and customer assistance.

Cost Benefit: Reduction of shoreline erosion contributes to better water quality, more recreational use of the shoreline, and reduced storm damage.

Potential Funding: County Operating Fund, Virginia DCR, NOAA

Schedule: Implementation with three years of plan adoption.

Recommended Action Item #5: Adopt an ordinance requirement for floodplain structure elevation to Base Flood Elevation plus two feet.

Issue/ Background: Currently, the County's floodplain management ordinance requires a freeboard of one foot above BFE. By adding an additional foot, structures will be protected from floods that exceed the 100-year flood, and insurance premiums will be reduced.

Other Alternatives Considered: No Action would result in continued enforcement of the one-foot freeboard, which does not provide property owners with maximum flood insurance premium discount.

Responsible Office: Code Compliance

Priority (H, M, L): Medium

Cost Estimate: Minimal cost of implementation.

Cost Benefit: By expending building costs for an additional course of block (approximately $1,500) for new and substantially improved structures, homeowners will realize significant reduction in flood insurance premiums, and a reduction in average annual damages. Cost to the County is minimal.

Potential Funding: Existing budgets.

Schedule: Within two years of plan adoption.

Recommended Action Item #6: Provide disaster mitigation planning assistance to small businesses.

Issue/ Background: In the lead-up and aftermath of Hurricane Isabel in 2003, necessary supplies were limited and small businesses that were not prepared had substantial business interruptions or, in some cases, failures. Damage from the storm's effects exacerbated the lack of planning and compounded the economic impacts. FEMA acknowledges that small- to medium-sized businesses provide nearly 80 percent of the jobs in an average community, but are at great risk for failure after a disaster; 30 to 40 percent never reopen after a disaster.

Other Alternatives Considered: Taking No Action would not alleviate the financial effects on small businesses from another disaster. Outreach to large businesses was also considered; however, large franchised retailers and other ventures with corporate backing are more resilient than small businesses.

Responsible Office: Community Services, Emergency Management

Priority (H, M, L): Medium

Cost Estimate: $50,000, to include staff time and outreach materials.

Cost Benefit: Experience has shown that advance planning and mitigation can significantly increase the likelihood that small businesses can survive a disaster, keeping a community economically viable and helping to fuel the recovery.

Potential Funding: SBA, Economic Development Administration, FEMA for materials, and County's annual operating budget for staff time and development of an assistance program with outreach component. The Association of Contingency Planners, Old Dominion Chapter, should be contacted to determine their level of interest and possible involvement. Their help in training business leaders could reduce costs significantly.

Schedule: Within one year of plan adoption. Community has already begun working with nursing homes, assisted living facilities, private schools and daycare centers with regard to mitigation planning and disaster recovery.

Recommended Action Item #7: Expand Drought-Resistant Landscaping Program elements, to include private property owners, commercial projects, and County lands.

Issue/ Background: Drought-related hazards in James City County are currently addressed through the James City Service Authority's (JCSA) WaterSmart program for homeowners, water use restrictions for irrigation, and rain sensor requirements for new irrigation systems. JCSA is the agency charged with operating the County's drinking water system. Activities include a comprehensive water management and education program to help residents maintain high quality landscaping while taking a smart approach to water use. However, the landscaping ordinance that applies to new County site plans does not require the same drought-resistant strategies, or provide incentives for using drought-tolerant plant species. The County must also address drought hazard management through wise use strategies on its own lands. The drought-resistant garden plot at the EOC is an excellent example of how the County can share hazard priorities with the public.

Other Alternatives Considered: Water restrictions during droughts are an imposition and inconvenience if property owners are not aware of the hazard. If drought-resistant strategies are espoused year-round for all property owners, and practiced by the County, the public is more receptive to water restrictions and other more extreme measures when necessary.

Responsible Office: James City Service Authority, Development Management, and Facilities Management (Parks & Grounds Maintenance)

Priority (H, M, L): Medium

Cost Estimate: Minimal staff time to revise Landscape Ordinance and seek approval.

Cost Benefit: By increasing drought-tolerant plant species, and drought-resistant landscaping techniques throughout the County, the use of water for irrigation will be reduced. Costs are minimal, but benefits will be apparent during droughts.

Potential Funding: Existing budgets.

Schedule: Implementation within one year of plan adoption.

Recommended Action Item #8: Convene a task force to study the wildland fire hazard and the urban interface. The task force could make recommendations regarding additional building code requirements in a mapped "interface zone", outreach and complementary inspections for homeowners, or additional building considerations to be distributed to builders.

Issue/ Background: The "high" wildfire hazard area for James City County covers 47.6 square miles (30,464 acres) in area and downed trees from recent tropical storms have dramatically increased the combustible fuel sources. As development pressure increases in parts of the County without public water supply, so do the number of structures in the urban interface at risk to fire. Two primary factors influence a home's ability to survive wildfire. These are the home's roofing material and the quality of the "defensible space" surrounding it. Teaching homeowners about "defensible space" is a valuable tool for the County.

Other Alternatives Considered: A simple outreach program for homeowners was also considered. Without mapping and careful consideration of outreach content, the program could alarm rather than inform residents.

Responsible Office: Emergency Management, Fire Department, GIS personnel

Priority (H, M, L): Low

Cost Estimate: $5,000 for outreach materials, plus minimal staff time for inspections and building code considerations. See **www.firewise.org** for additional materials.

Cost Benefit: Minimal costs would result in a marked increase in homeowner awareness of the fire hazard and measures that could be taken on individual properties to mitigate the hazard. Average annual damages from fire would be minimized through individualized inspections and targeted recommendations.

Potential Funding: Existing budgets.

Schedule: Task Force creation within two years of plan adoption; implementation of task force recommendations within additional two years.

6.3.5 York County Mitigation Recommendations

Recommended Action Item #1: Revise floodplain management ordinance to: 1) adopt cumulative substantial improvement rule; and, 2) adopt two feet of freeboard above the Base Flood Elevation. Additions/renovations within a ten-year time frame that cumulatively equal 50 percent of a structure's appraised value trigger compliance with the ordinance's elevation requirements.

Issue/Background: County building officials currently make strong recommendations regarding freeboard in an effort to reduce flood insurance premiums for new structures. Codifying the recommendation is the next logical step, and would result in CRS creditable points. Property owners aware of the current substantial improvement requirements may circumvent the rule by making piecemeal improvements to the structure to avoid triggering the elevation requirements.

Other Alternatives Considered: Other alternatives to the 10-year cumulative substantial improvement rule were examined, including a shorter, 5-year accumulation period. Ten years seems appropriate for the level of renovations taking place, has worked well for other communities, and shorter time periods can cause conflicts with property re-sales.

Responsible Office: Department of Environmental and Development Services, Building Regulations and York County Board of Supervisors

Priority (H, M, L): High

Cost Estimate: Staff Time

Cost Benefit: Evidence of the effectiveness of elevating structures above the Base Flood Elevation is ample. The cumulative substantial improvement rule would help ensure that the value of flood-prone structures is not continually increased without being protected from flooding. The rule would also help address repetitive losses that may otherwise never meet the 50 percent criteria. Freeboard above the BFE reduces the chance of flooding based on mapping inaccuracies, floods that exceed the base flood, and damage from floating debris. CRS points are available for this activity, and York County is a CRS participant.

Potential Funding: None.

Schedule: Implementation contingent on funding and staffing availability.

Recommended Action Item #2: Implement flood hazard awareness program to: 1) inform existing property owners of their flood zone designation and flood insurance availability; 2) inform property owners and surveyors of FEMA's map amendment process; and, 3) incorporate flood hazard awareness into Site Plan and Building Permit processes.

Issue/Background: Many property owners are not aware that, in conjunction with a local surveyor, they can more accurately ascertain the boundaries of the Special Flood Hazard Area depicted on the Flood Insurance Rate Maps (FIRM). The FEMA map amendment process can then be used to officially modify the FIRM if existing topography does not match FIRM boundaries. Accurately completed Elevation Certificates also benefit property owners by more precisely describing the pertinent site elevation data. Such a flood hazard awareness program is a creditable activity under CRS. Only 50 percent of the structures within York County floodplains currently carry flood insurance. The County is committed to ensuring ongoing compliance with NFIP requirements.

Responsible Office: Department of Financial and Management Services, Computer Support Services, Department of Environmental and Development Services, Building Regulations, Department of Fire and Life Safety, Office of Emergency Management, Virginia Department of Conservation and Recreation, and the Virginia Association of Surveyors, Inc.

Priority (H, M, L): High

Cost Estimate: Staff Time

Cost Benefit: Property owners would obtain more accurate flood zone determinations in the long run, which could reduce insurance premiums or increase flood insurance coverage, depending on the risk. Knowledge of flood hazards early in the building process reduces the likelihood of compliance issues.

Potential Funding: Existing budgets

Schedule: On-going

Recommended Action Item #3: Storm Water Capital Improvement Projects

Issue/Background: According to the York County Strategic Capital Improvements Plan for Waste and Storm Water, several county drainage systems are not properly sized for their respective drainage area, and resultant flooding is problematic.

Responsible Office: Department of Environmental and Development Services, Utilities

Priority (H, M, L): High

Cost Estimates: $ 5,000,000

Cost Benefit: Reduces homeowner losses due to urban flooding and enhances public safety services by reducing flooding of roadways and maintaining access to most areas of the County

Potential Funding: General Fund - Capital Improvement Projects; also, VDOT Revenue Sharing Program funds for projects with VDOT rights-of-way.

Schedule: Implementation over the next five years.

Recommended Action Item #4: Evaluate critical facilities for safety and sustainability during emergencies and take appropriate corrective actions to include providing backup power to critical facilities to protect the public and maintain continuity of government.

Issue/Background: York County experiences all types of severe weather, which stresses the structural integrity of critical facilities and infrastructure, i.e. electrical utilities. The County plans to complete a survey of critical facilities to determine the most effective and efficient use of space and take appropriate corrective actions to protect the occupants of these facilities and maintain continuity of government services. The electric company's power restoration priorities serve areas within higher population densities and consequently many areas of York County remain without power for longer periods than those areas with higher population density. It is not unusual for areas of the County to be without power for several weeks during severe winter weather. The County desires to establish a warming or cooling shelter to be used in times of severe weather emergencies, this would require the shelter to have backup power to run the HVAC system along with lighting in shelter areas, hot water, and the capability to store and prepare food, and certain outlets powered to support medically/electric dependent residents. Other shelters require sufficient backup power to support lighting in shelter areas, power up certain electric outlets, hot water, and capacity to store and prepare food. The County is considering several existing buildings as an alternate EOC; however, none of the facilities under consideration have generator power. The County Fire Stations have backup power; however, during Isabel it was realized that the backup power was not sufficient to support first responders working from those locations. Other facilities critical to maintaining continuity of government, which have been identified by the County, have no backup power as well.

Other Alternatives Considered: To stay with current practices and provide no backup power at shelters, alternate EOC or other facilities critical to continuity of government.

Responsible Office: York County Department of Fire and Life Safety, Office of Emergency Management, York County School Division, York County Department of Financial and Management Services, and York County Department of General Services.

Priority (H,M,L) High

Cost Estimate: $1,000,000 – $ 2.500,000

Cost Benefit: Ensuring the critical facilities are being used to their highest effective and efficient use with appropriate safeguards and backup power is an important emergency mitigation consideration. Having a shelter where the space is used most efficiently and effectively, which receives those who are medically dependent on electricity or who are frail with low tolerance to severe weather can be life sustaining. Sheltering becomes a more desirable alternative to staying at home, which reduces the risk of individual house fires, injuries, and the consumption of spoiled food. Adequate backup power at fire stations ensures that there will be HVAC at each station during an emergency, that there is adequate lighting, access to computers, communications, hot water, and a means to prepare and store food. In order to maintain continuity of government in an emergency, backup power for alternate EOC is essential to maintaining response and recovery activities if damage occurs to the existing facility. Also, other critical facilities have been identified by the County to maintain the continuity of government in an emergency and they will be included in this project.

Potential Funding: General Fund – Capital Improvement Projects, cost share with the school division; and grants.

Schedule: Implementation contingent on funding availability.

Recommended Action Item #5: Maintain low-density zoning in flood-prone areas.

Issue/Background: Many parcels in the floodplain are currently vacant, but capable of being subdivided and developed. Maintaining these areas as low-density residential (1 unit per acre is the current land use standard for low-density residential development) will limit the potential number of residences subject to future flood damages. Financial strategies and incentives should be explored as part of this solution. Examples include purchase or transfer of development rights and lease-back arrangements.

Other Alternatives Considered: An alternative to this measure would be to rezone flood-prone areas to require more than one acre per dwelling unit (such as the RC

Resource Conservation district, which requires 5 acres per unit). However, reduction of property values and concerns regarding legislative land takings make this alternative infeasible.

Responsible Office: County Administration, Planning Division, and York County Board of Supervisors

Priority (H, M,L): High

Cost Estimate: Staff Time

Cost Benefit: The investment of time and minimal funds necessary to protect these areas from development will significantly reduce flood damage to future development, and reduce potential loss of life. Numerous CRS points are available for this activity.

Potential Funding: Existing budgets

Schedule: Ongoing

Recommended Action Item #6: Increase accessibility to digital elevation certificate data.

Issue/ Background: Currently, completed elevation certificates are collected and entered into the County's computer system using FEMA software program. The data is entered by the County Building Official and is time consuming. The software has limitations in data retrieval and sorting. The software needs to be adapted to be user friendly and provide more utility.

Other Alternatives Considered: Paper copies are bulky and do not last as long as digital data. No Action would result in continued problems accessing data for other floodplain management purposes.

Responsible Office: Department of Environmental and Development Services, Building Regulation, and Department of Financial and Management Services, Computer Support Services.

Priority (H, M, L): Medium

Cost Estimate: Minimal cost for staff time to reconfigure database access.

Cost Benefit: Sharing of this data will increase opportunities for mitigation projects, and provide emergency management and land-use planners with a useful floodplain management tool at minimal cost. CRS points available for this activity.

Potential Funding: Existing budgets

Schedule: Implementation contingent on staffing and available technology.

Recommended Action Item #7: Site plan submitted with the building permit application shall include detailed information on the flood hazard, to include flood zone, map number and date, and base flood elevation.

Issue/Background: All of the applications and checklists do not currently require this information.

Other Alternatives Considered: No action with regard to this activity could jeopardize participation in the NFIP and CRS. Revision of simply the Building Permit form would satisfy NFIP requirements, but all other such documents should be examined simultaneously to provide clear direction to builders and developers.

Responsible Office: Department of Environmental and Development Services, Building Regulations, and the Division of Development and Compliance

Priority (H, M, L): High

Cost Estimate: Staff time and copying costs

Cost Benefit: Clear direction regarding implementation of the floodplain management ordinance and information about flood risk reduces compliance issues and results in structures that are at less risk of flood damage.

Potential Funding: Existing budgets.

Schedule: On-going

Recommended Action Item #8: Maintain an awareness of and support for the Newport News Department of Public Utilities (Waterworks) forest management program to mitigate wildfire hazards and promote the health of forests within the reservoir watersheds. Eight percent of the land area in York County is owned by Newport News Waterworks and is considered part of the reservoir watershed.

Issue/Background: The Newport News Department of Public Utilities (Waterworks) has maintained a comprehensive forest management program for over 20 years. The program includes fire trails, clear-cutting, thinning, disease control and other elements to maintain healthy forests. The program works in conjunction with a Newport News Watershed Protection ordinance. Additionally, coordination of property owners must take place. Fifty percent of York County is subject to fire, but 17 percent of that land is owned and managed by the federal government.

Other Alternatives Considered: Due to the wildfire hazard risk in York County, this practice cannot be ignored.

Responsible Office: Newport News Waterworks, Chief of Forest Resources in coordination with York County Department of Environmental and Development Services, Division of Utilities and the Department of Fire and Life Safety, Division of Fire Prevention and Life Safety

Priority (H, M, L): Medium

Cost Estimate: Staff time

Cost Benefit: The forest program's main objective is water quality protection, and it helps maintain the quality of the system's existing raw water sources, but more importantly is serves as a means to reduce the risk of wildfire hazards in the watershed areas.

Potential Funding: Existing budget for personnel costs

Schedule: Ongoing.

Recommended Action Item #9: Support a comprehensive water conservation program to mitigate drought hazards.

Issue/Background: Newport News Department of Public Utilities (Newport News Waterworks) developed a water conservation program approximately 15 years ago and it was modified in 2005 (effective January, 2007). The plan is based on encouraging water conservation through surcharges and penalties for excess use, and restrictions during drought conditions. This plan has proven to be effective as Waterworks has one of the lowest per capita water uses in the state. The plan covers all jurisdictions in the Waterworks service area, including: Newport News, Hampton, and portions of York and James City County. The proposed action involves continued implementation of the program, with additional activities and programs added, as necessary.

Other Alternatives Considered: The Department is considering additional sources of potable water and raw water through creation of a new reservoir. No Action to renew the water conservation plan could create more damages resulting from drought hazards.

Responsible Office: Newport News Waterworks in coordination with York County Department of Environmental and Development Services, Division of Utilities

Priority (H, M, L): Medium

Cost Estimate: Staff Time

Cost Benefit: The water conservation plan and its associated activities help maintain water supply during drought conditions.

Potential Funding: Existing budget for personnel costs.

Schedule: Ongoing

Recommended Action Item # 10: Provide contingency planning assistance to small businesses.

Issue/Background: In the lead-up and aftermath of Hurricane Isabel in 2003, necessary supplies were limited and small businesses that were not prepared had substantial business interruptions due to power outages and/or structure damage. Damage from the storm's effects exacerbated the economic effects on several small businesses. These businesses couldn't provide the needed goods and services to customers, many of whom were County residents during the immediate recovery efforts.

Other Alternatives Considered: Taking " No Action" would not alleviate the damaging effects on small business during another disaster. Outreach to large businesses can be considered; however, large franchised retailers and other ventures with corporate backing are more resilient than small businesses.

Responsible Office: County Administration, Office of Economic Development and Department of Fire and Life Safety, Office of Emergency Management, York County Chamber of Commerce

Priority (H, M, L): Medium

Cost Estimate: Staff time, workshop costs, and outreach materials.

Cost Benefit: Advance planning and mitigation can significantly increase the likelihood that small businesses can survive a disaster, keeping a community economically viable and helping to fuel the recovery.

Potential Funding: Grants from agencies, such as SBA, existing County budget for personnel costs, and assistance from York County Chamber of Commerce and other organizations, such as the Association of Contingency Planners, Old Dominion Chapter.

Schedule: Implementation contingent on staffing and funding availability

Recommended Action Item #11: Achieve Storm Ready Certification from the National Weather Service.

Issue/Background: Storm Ready is a nationwide community program that uses a grassroots approach to help communities develop plans to handle severe weather. The program signifies to the public that a community has developed procedures for operational response to severe weather. Currently York County coordinates with York County School Division for tornado awareness and exercises with the school division every spring. The County has a number of procedures in place for response to severe weather. However, the County hasn't completed the application process for Storm Ready designation.

Other Alternatives Considered: Taking the actions necessary to achieve Storm Ready Certification without applying for the certification was considered, but rejected. The certification is a means to keep the public informed about the importance of being prepared and that the community places it as a high priority.

Responsible Office: Department of Fire and Life Safety, Office of Emergency Management

Priority (H, M, L): High

Cost Benefit: Applying for StormReady designation and maintaining the criteria to keep the designation places the importance and awareness as a high priority in the community and with the public.

Potential Funding: Existing budget for personnel costs.

Schedule: Implementation contingent upon staffing priorities.

Recommended Action Item #12: Implement the Comprehensive Plan element "protect County shorelines from erosion through a coordinated, unified area approach that utilizes properly designed methods of vegetative or structural stabilization, bank regrading, beach nourishment and/or relocation of activities to less sensitive areas."

Issue/ Background: The County's Erosion and Sediment Control program adequately regulates land disturbance activities in accordance with State regulations. Missing is a program element to address existing shoreline problem areas that can exacerbate storm damage, and detrimentally affect water quality. A citizen advisory/assistance program for shoreline erosion, in conjunction with the knowledgeable professionals of Virginia Department of Conservation and Recreation's Shoreline Erosion Advisory Service would address this deficiency.

Other Alternatives Considered: Regulating new development projects, while overlooking shoreline problems. Private property owners are often unaware of the most cost-effective and successful strategies to adequately address shoreline erosion problems. Having a program in place to intercept and help property owners before they have to take drastic action, or before they take action without a permit, benefits both the County and property owners.

Responsible Office: Virginia DCR

Priority (H, M, L): Medium

Cost Estimate: $10,000 for public outreach and staff time to support project identification and customer assistance.

Cost Benefit: Reduction of shoreline erosion contributes to better water quality, more recreational use of the shoreline, and reduced storm damage.

Potential Funding: County Operating Fund, Virginia DCR, NOAA, Colonial Soil & Water Conservation Service

Schedule: Implementation contingent on funding availability.

Recommended Action Item #13: Elevate flood-prone homes/reduce repetitive flood losses

Issue/Background: Reduce property damage from repetitive flooding by elevating homes in flood-prone areas of the county that meet criteria of the HMPG and other floodplain management elevation programs. There are 30 repetitive loss properties in York County. A repetitive loss plan is a requirement of CRS participation when there are more than 10 repetitive losses.

Other Alternatives Considered: Relocation of flood-prone structures was considered, but York County is relatively built-out and the floodplain area is extensive. Acquisition of properties and relocation of residents would be prohibitively expensive to undertake.

Responsible Office: Office of Emergency Management and Planning Office

Priority (H, M, L): High

Cost Estimate: $30,000 per home (estimate 50 homes); total of $1,500,000

Cost Benefit: Average annual damages are substantially reduced when structures are elevated to or above the Base Flood Elevation.

Potential Funding: Hazard Mitigation Grant Program, FMA, PDM

Schedule: Implementation contingent on funding availability.

7.0 Plan Implementation and Maintenance

Implementation implies two concepts: action and priority. While this plan puts forth many worthwhile recommendations, the decision regarding which action to undertake first will be the initial issue each community faces. Committee members should not only account for priority when considering which task should be addressed first, they should also consider the issue of funding. Therefore, low or no-cost recommendations have the greatest likelihood of succeeding. An example would be updating the floodplain management ordinance to mandate two feet of freeboard. These efforts would lead to long-standing changes in vulnerability and can be initiated at very little cost, while simultaneously reducing flood insurance premiums.

Another important implementation mechanism that is highly effective but low-cost is taking steps to incorporate the recommendations, and equally important, the underlying principles of this Hazard Mitigation Plan into other community plans such as the Comprehensive Plan, capital improvement budgeting, economic development goals and incentives, and other such plans. Mitigation is most successful when it is incorporated within the day-to-day functions and priorities of government and development. This integration is accomplished by a constant, pervasive and energetic effort to network and to identify and highlight the multi-objective, "win-win" benefits to each program, the community and the constituents. This effort is achieved through monitoring agendas, attending meetings, sending memos, and promoting a safe, sustainable community.

Monitoring funding opportunities should be done simultaneously with the integration effort. Funding can be leveraged to implement some of the more costly recommendations. A bank of ideas on how any required local match or participation requirements can be met should be created and maintained. Being aware of when funding becomes available will allow the Committee to capitalize upon important opportunities. Funding opportunities that can be monitored include special pre- and post-disaster funds, special district budgeted funds, state or federal ear-marked funds, and grant programs, including those that can serve or support multi-objective applications.

With the adoption of this plan, the PHMPC will be converted to a permanent advisory body referred to as the Mitigation Coordinating Committee. This Committee agrees and commits to:

- Act as a forum for hazard mitigation issues,
- Disseminate hazard mitigation ideas and activities to all participants,
- Pursue the implementation of the high priority, low/no-cost Recommended Actions,
- Keep the concept of Mitigation in the forefront of community decision-making by identifying the recommendations of this plan when other community goals, plans, and

activities overlap, influence, or directly affect increased community vulnerability to disasters,

- Maintain a vigilant monitoring of multi-objective cost-share opportunities to assist the community in implementing the Recommended Actions of this plan for which no current funding or support exists,
- Monitor implementation of this Plan,
- Report on progress and recommended changes to the City/County Manager's Office, and
- Inform and solicit input from the public.

The Committee will not have any powers over City/County staff; it will be purely an advisory body. Its primary duty is to see the plan successfully carried out and to report to the City/County Manager's Office and the public on the status of plan implementation and mitigation opportunities in the Peninsula communities. Other duties include reviewing and promoting mitigation proposals, hearing stakeholder concerns about hazard mitigation, passing the concerns on to the appropriate entities, and posting relevant information on the community's website.

7.1 Maintenance

Plan maintenance implies an ongoing effort to monitor and evaluate the implementation of the plan, and to update the plan as progress, roadblocks, or changing circumstances are recognized. This monitoring and updating will take place through an annual review by the Committee and a five-year written update to be submitted to the state and FEMA Region III, unless disaster or other circumstances (e.g. changing regulations) lead to a different timeframe.

When the Committee convenes for the review, they will coordinate with all stakeholders that either participated in the original planning process, or have joined the Committee since the inception of the planning process. The goal will be to update and revise the plan. Public notice will be given and public participation will be encouraged. The invitation to participate will be extended via web-postings and press releases to the local media outlets.

The evaluation of progress can be achieved by monitoring changes in the vulnerability identified in the Plan. Changes in vulnerability can be identified by noting:

- Lessened vulnerability as a result of implementing Recommended Actions;
- Increased vulnerability as a result of failed or ineffective mitigation actions; and/or,
- Increased vulnerability because of new development.

The updating of the plan will be accomplished through written changes and submissions as the Committee deems necessary, and as approved by the governing bodies of each community.

Appendix A

Hazard Mitigation Planning Committee Member List

Hazard Mitigation Planning Committee Member List

Community	First Name	Last Name	Title	Agency
Hampton	James	Freas		Planning Dept.
	Libby	Griebel		Senior Appraiser
	Allan	Lambert		GIS Manager
	David	Langille		Chief Inspector
	Jim	Redick	Deputy E. M. Coordinator	Emergency Mgmt
	Tammy	Waldroup	Assistant Planner	Planning Dept.
	Donald	Whipple		Senior City Planner
Newport News	Carol	Caldwell	Codes Compliance	
	David E.	Gossett	Self-Insurance Programs, Admin.	Self-Insurance Programs
	Mark	Hargrave	GIS Supervisor	Dept. of Engineering
	Ralph	Harris	Senior Appraiser	Real Estate Assessor
	Kenny	Holloway	Street Division, Asst. Admin.	Public Works, Street Div
	Kathy	James-Webb	Planner, Senior	Dept. of Planning
	Doug	Kennedy	Superintendent of Landscape Services	Parks & Recreation
	Kris E.	Keyes	Human Resources Manager	Waterworks
	Eric	Lamberton	Public Works, Asst. Director	Public Works
	Theresa	Lazar	Deputy Coordinator	Office of Emergency Management
	Lou	Marks	Codes	Codes Compliance
	Antonio	Risk	Engineering, Senior Tech.	Public Works
	Harold	Roach	Codes	Codes Compliance
	Emily	Seward	Planner, Emergency	Emergency Management
	Joe	Street	City Assessor	Real Estate Assessor
	Dick	Tyson	Shelter Coordinator	Public Schools
	David	Watson	Environmental Planner	Dept. of Planning
	Deirdre	Wells		Engineering
	Andrew S.	Wilks	Property Manager	Department of Development
Williamsburg	Jason	Beck	Zoning Officer	Planning
	Bert	Geddy	Fire Chief, Deputy & Deputy Coord	Williamsburg Fire Dept
	Cindy	Greczek	Colonial Williamsburg	Deputy Dir. Of Safety
	Bob	Iversen	Utilities Superintendent	Utilities
	Robert	Johnson	Fire Safety Officer	Facilities Management
	Ted	Lyman		GIS Consultant
	John	Mattson		City Assessor
	Jim	Murphy		Deputy Coord.
	Lori	Rierson	Recreation Dept.	Deputy Director
College of William & Mary	Larry	Richards	Safety & Environmental Health	Assc. Director of Safety
William & Mary	Jack	Williamson	Emergency Mgmt, Coordinator	Emergency Management
W'burg-JCC Schools	Jay	Sexton		Williamsburg Police
James City County	George	Adams	Utility Operations Administrator	JCSA

Community	First Name	Last Name	Title	Agency
	Wilton	Bobo	Emergency Services	Deputy Coord.
	Ellen	Cook	Planner	Development Management
	Pat	Foltz	GIS, Development Tech.	Development Management
James City County	Emmett H.	Harmon	Deputy Chief of Police	County Police Department
	Kim	Hazelwood		GIS
	Jane	Leonard	Administrative Services Coordinator	James City County
	A. Vaughn	Poller	Planner, Community Dev.	JCC Office of Housing & Community Development
	Doug	Powell	Assistant Manager	Community Services
	Bob	Ryalls		
	Matt	Smolnick		
	Alan	Robertson	Facilities Manager	W'burg JCC Schools
York County	Connie	Bennett	Stormwater Engineer	Env'l & Development
	Timothy	Cross	Planner, Principal	Planning Division
	Jim	Dishner	FM, Asst. Chief, Dep Coord	York Co. Fire Dept.
	Marianne G.	Harris	Building Code Official	Building Regulation
	Korine	Leonard	GIS Supervisor	York County
	Al	Maddalena	Chief of Development & Compliance	Development & Compliance
	Amy	Parker	Planner, Senior	Planning Division
	Stephanie	Peters	GIS Analyst	York County
	Judith N.	Riutort	Emergency Mgmt, Deputy Coord.	Fire & Life Safety
	Greg	Thacker		County Assessor
HRPDC	Tammy	Kaarlgard	HRPDC	Planner
Langley AFB	MSGT Darryl	Hart	USAF	1st Civil Engineering
State of Virginia	Hibak	Hersi	Va. Dept. of Emerg. Mgmt.	Local Haz. Mit. Planner
State of Virginia	Brittany	Schaal	Va. Dept. of Emerg. Mgmt.	Local Haz. Mit. Planner

Appendix B

Hazard Specific Mapping

B-2 – B-4 Peninsula Hurricane Tracks
B-5 Peninsula Tornados, 1950-2002
B-6 Landslide Hazard Map

Peninsula Hurricane Tracks, 1851-1899

Hurricanes Passing Within 25 Nautical Miles of Newport News, VA

Year	Month	Day	Storm Name	Wind Speed (Kts)	Pressure (Mb)	Category
1854	September	10	not named	40	not available	Tropical Storm
1856	August	19-20	not named	50	not available	Tropical Storm
1859	September	17	not named	50	not available	Tropical Storm
1861	September	27	not named	60	not available	Tropical Storm
1863	September	18	not named	50	not available	Tropical Storm
1872	October	25-26	not named	40	not available	Tropical Storm
1874	September	29	not named	50	not available	Tropical Storm
1877	October	4	not named	50	not available	Extratropical
1881	September	10	not named	50	not available	Tropical Storm
1882	September	11	not named	40	not available	Tropical Storm
1882	September	23	not named	40	1005	Tropical Storm
1886	July	2	not named	35	not available	Tropical Storm
1889	September	24-25	not named	40	not available	Tropical Storm
1894	October	10	not named	60	not available	Tropical Storm

Source: NOAA CSC Hurricane Mapping Tool

Peninsula Hurricane Tracks, 1900-1949

Hurricanes Passing Within 25 Nautical Miles of Newport News, VA

Year	Month	Day	Storm Name	Wind Speed (Kts)	Pressure (Mb)	Category
1902	June	16	not named	40	not available	Extratropical
1904	September	15	not named	55	not available	Tropical Storm
1924	September	30	not named	35	not available	Extratropical
1928	August	12	not named	30	not available	Extratropical
1928	September	19	not named	40	989	Tropical Storm
1933	August	23	Chesapeake-Potomac Hurricane	60	971	Tropical Storm
1944	October	20-21	not named	35	996	Tropical Storm

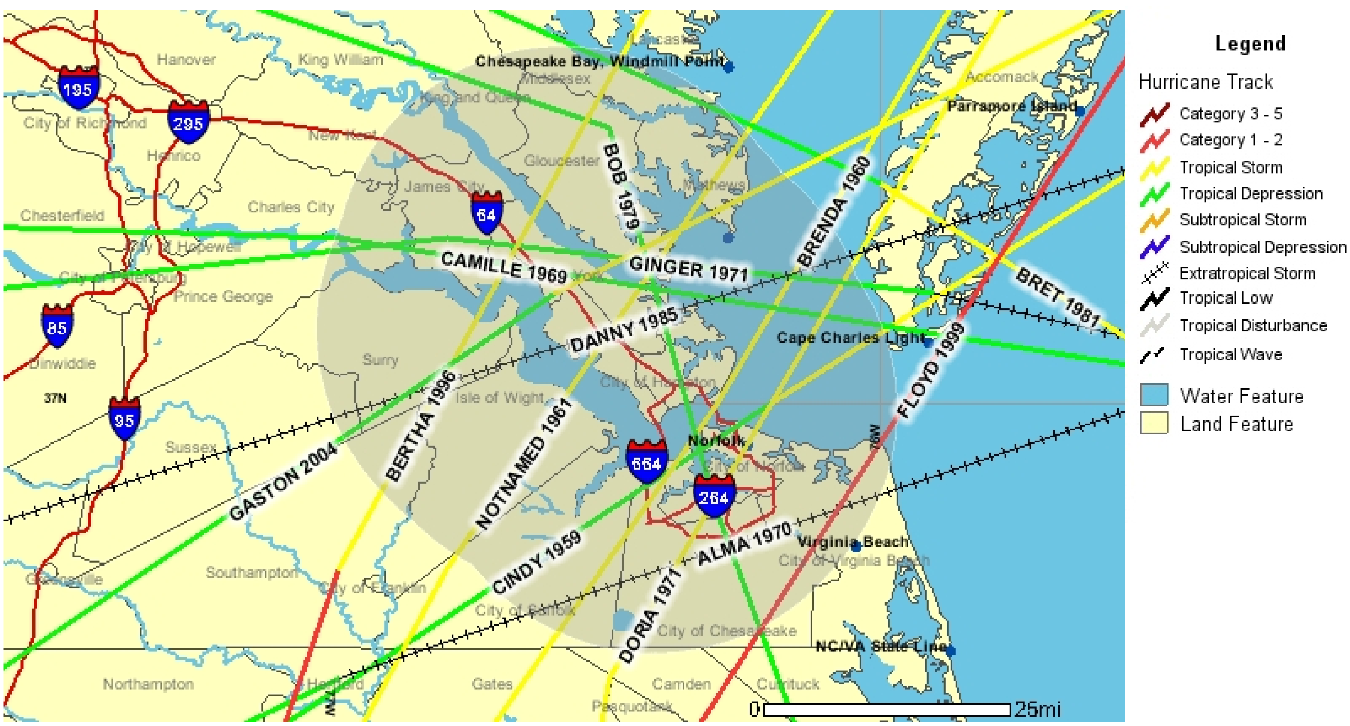
Source: NOAA CSC Hurricane Mapping Tool

Peninsula Hurricane Tracks, 1951-2004

Hurricanes Passing Within 25 Nautical Miles of Newport News, VA

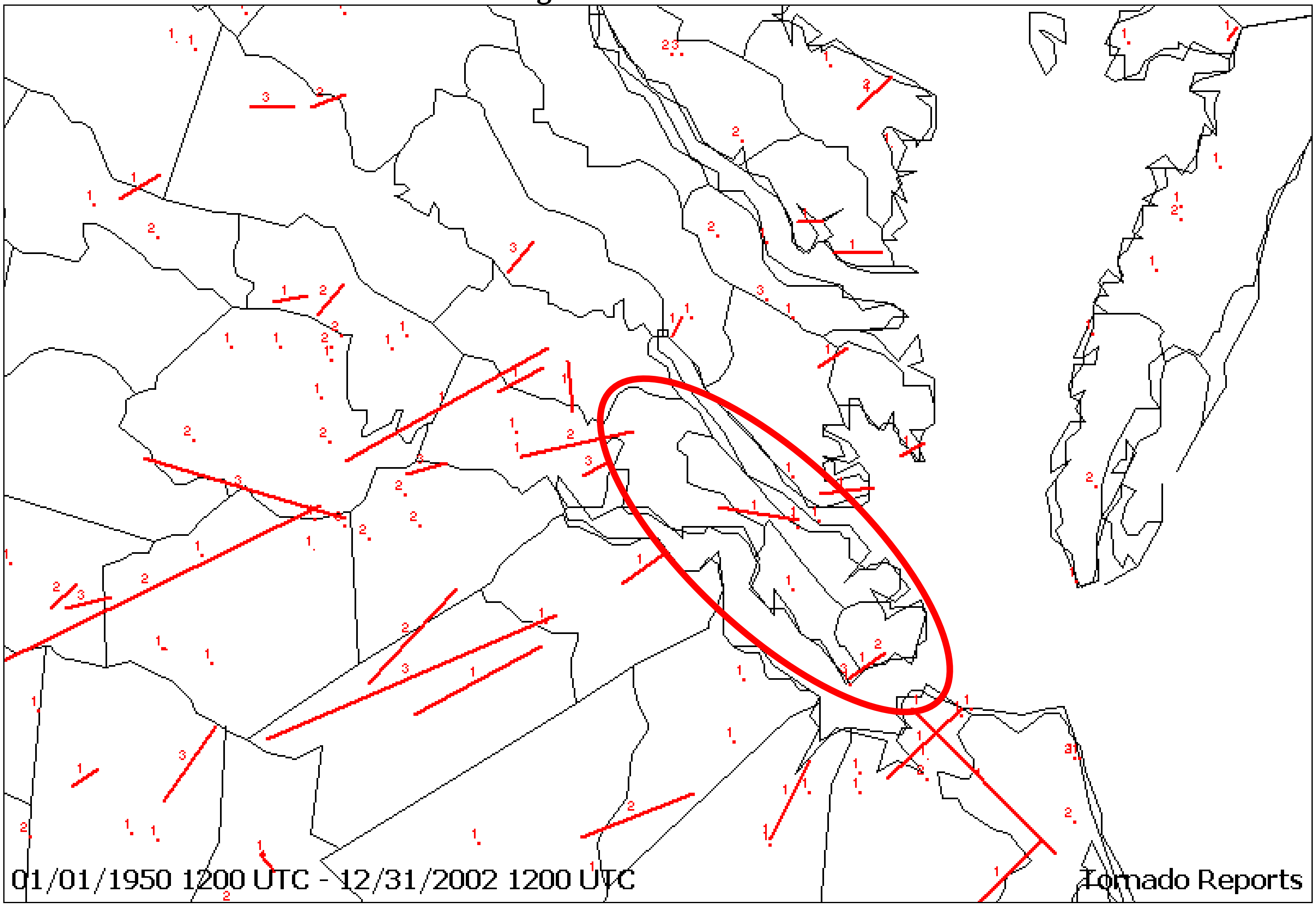
Year	Month	Day	Storm Name	Wind Speed(Kts)	Pressure(Mb)	Category
1959	July	10	Cindy	30	0	Tropical Depression
1960	July	30	Brenda	50	0	Tropical Storm
1961	September	14	not named	35	0	Tropical Storm
1969	August	20	Camille	25	0	Tropical Depression
1970	May	27	Alma	25	1003	Extratropical
1971	August	28	Doria	55	0	Tropical Storm
1971	October	2-3	Ginger	30	0	Tropical Depression
1979	July	14-15	Bob	20	1010	Tropical Depression
1981	July	1	Bret	30	1006	Tropical Depression
1985	August	19	Danny	25	1012	Extratropical
1996	July	13	Bertha	60	993	Tropical Storm
1999	September	16	Floyd	70	967	Hurricane – Category 1
2004	August	30-31	Gaston	30	1002	Tropical Depression

Note: The eye of Hurricane Isabel (2003) did not pass within 25 nautical miles of the Peninsula and, therefore, does not appear in this database or mapping.



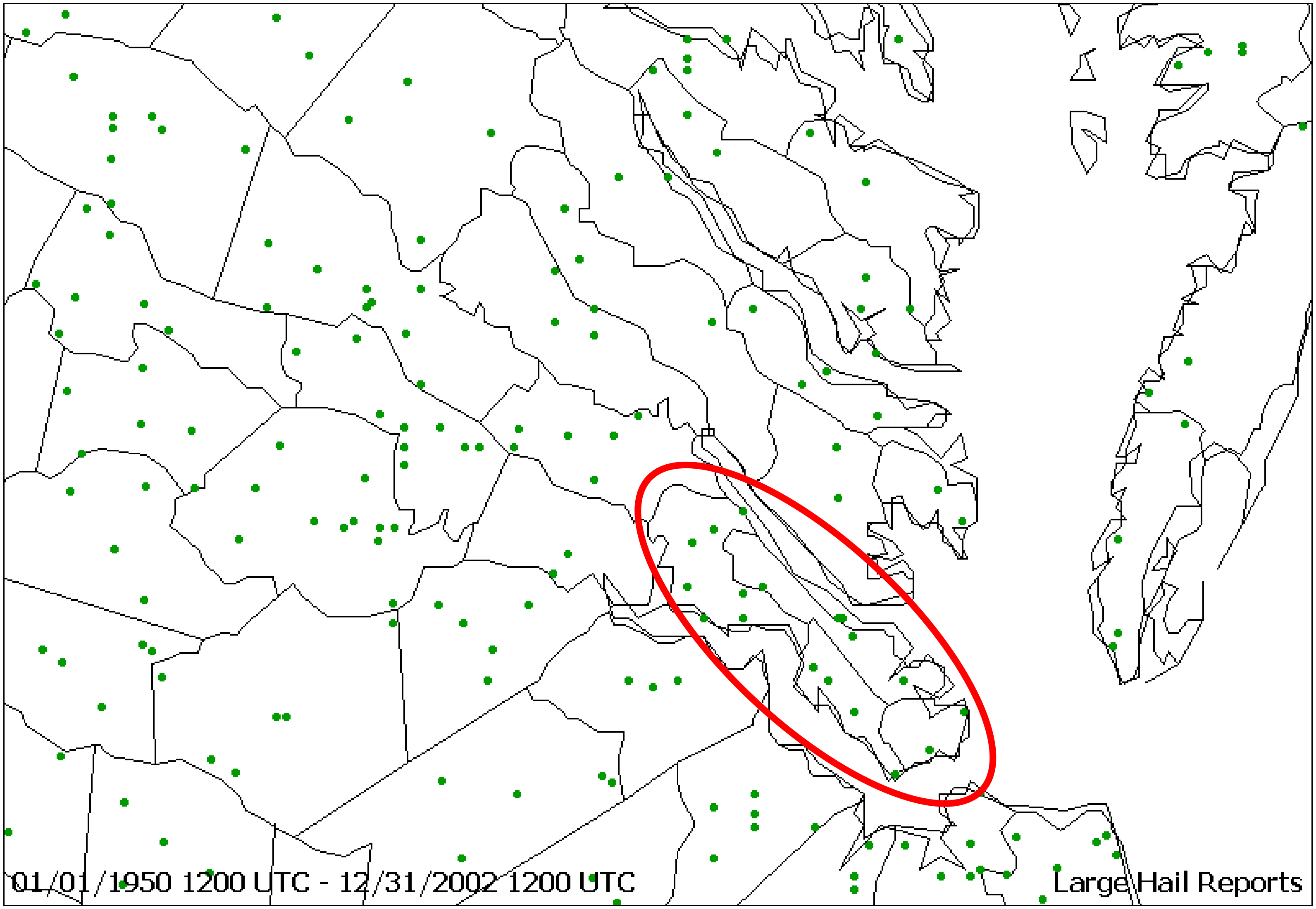
Source: NOAA CSC Hurricane Mapping Tool

Peninsula Reported Tornado Tracks, 1950-2002
Magnitude F1 or Greater



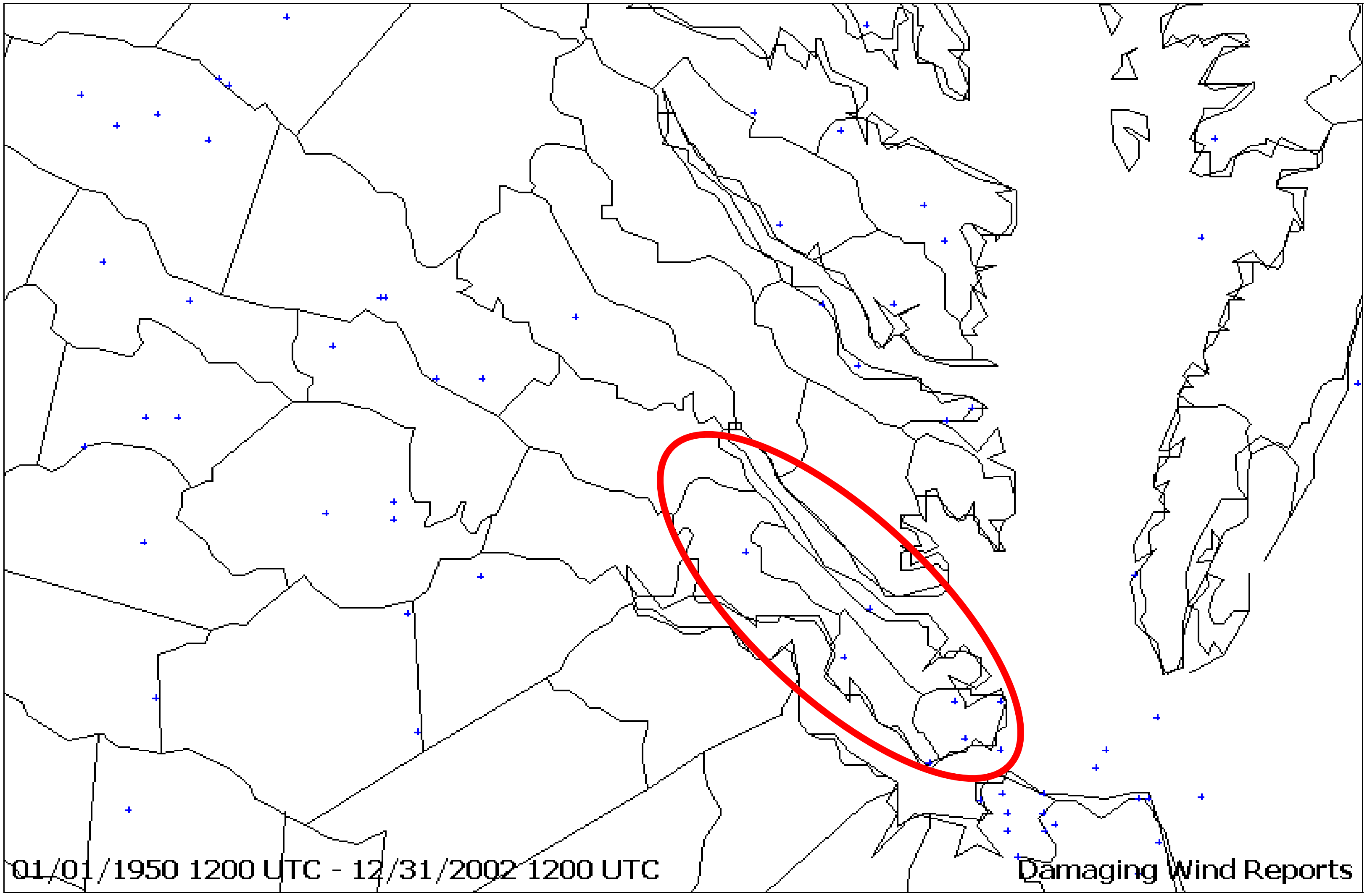
Source: NWS SVRPLOT Output

Peninsula Large Hail Reports, 1950-2002
Hail Greater than 1 inch



Source: NWS SVRPLOT Output

Peninsula Damaging Wind Reports, 1950-2002
Sustained Wind Greater than 60 knots



Source: NWS SVRPLOT Output

Appendix C
Catalog of Virginia's Historical Hurricanes

Catalog of Virginia's Historical Hurricanes

The following catalog has been compiled from records of the National Weather Service, Wakefield Office (www.erh.noaa.gov/akq), and a web site on *Virginia's Hurricane History* researched by David Roth with the Hydrometeorological Prediction Center in Camp Springs, Maryland, and Hugh Cobb, with the National Weather Service Forecast Office in Wakefield, Virginia (http://www.hpc.ncep.noaa.gov/research/roth/vahur.htm).

Continuous weather records for the Hampton Roads Area of Virginia began on January 1, 1871 when the National Weather Service was established in downtown Norfolk. The recorded history of significant tropical storms that affected the area goes back much further. Prior to 1871, very early storms have been located in ship logs, newspaper accounts, history books, and countless other writings. The residents of coastal Virginia during Colonial times were very much aware of the weather. They were a people that lived near the water and largely derived their livelihood from the sea. To them, a tropical storm was indeed a noteworthy event. The excellent records left by some of Virginia's early settlers and from official records of the National Weather Service are summarized below. Learning from the past will help us prepare for the future.

SIXTEENTH CENTURY

Note: Dates before September 2, 1752 converted from the Julian to the Gregorian calendar

The Spanish were becoming nervous about French activity in the New World, particularly along the Atlantic coast. This worried the Spanish because they used the Gulf Stream to move their plunder from old Mexico and Florida back to Spain. King Phillip II demanded the settlement of the coast in 1558, leading to the first explorations of the region around Virginia (Lewis & Loomie).

1564 The Native American population of the area told of a shipwreck during that year. A "christian shippe" was beaten by a storm; none aboard survived the ordeal. The natives made instruments from the nails and spikes off the vessel. (Chapman)

1566 June 14 (Old Style): Four vessels of Angel Villafañe's fleet were passing offshore Hatteras. On the 14th, two small vessels perished, while Villafañe's caravel nearly foundered. The remaining two vessels eventually made their way to Havana (Lewis & Loomie).

1586 June 23-26 Sir Francis Drake arrived near Roanoke Island, only to be greeted by a storm. It was described as "extraordinary" and lasted three days. His fleet was in great danger during the tempest. The Primrose broke its 250-pound anchor. Hail the size of hen eggs pelted the colony. Waterspouts also threatened the mariners. The settlers evacuated back to England soon after the storm.

1587 August 31 Admiral Drake encountered a hurricane at Roanoke Island during the following year. Strong northeast gales caused him and his crew to "cut his cables" and set out to sea. It took six days to regroup after this treacherous storm.

1591 August 26 Roanoke Island was again struck by a severe storm. The winds blew out of the northeast, directly into the harbor. Waves crashed on a sandbar and currents in the area became quite dangerous.

SEVENTEENTH CENTURY

1609 August 4 (The Tempest): Sir Thomas Gates, future governor of Virginia, was on his way to England from Jamestown. On Saint James Day, while between Cuba and the Bahamas, a "most terrible and vehement storm" raged for 44 hours. One of the small vessels in the fleet sank to the bottom of the Florida Straits. Four of the remaining vessels reached Virginia soon after the storm...followed a few days later by three other ships.

The flagship, known as Sea Adventure, disappeared and was presumed lost. A small bit of fortune befell the ship and her crew when they made landfall on Bermuda. Although the vessel was damaged on a surrounding coral reef, all survived and spent ten months on the unsettled isle. The Spaniards, though shipwrecked on the island many times, had failed to colonize there.

The British claimed the island and quickly settled the subtropical isle. In May 1610, they set forth for Jamestown, this time arriving at their destination. This near catastrophe provided the inspiration and background for William Shakespeare's play, The Tempest.

1635 August 24: First historical reference to a major hurricane that could have affected the VA coast. A major hurricane affected the Virginia coast as it moved to the east of the colony. Despite its impact in New England, no references to damage in Virginia has been found.

1649: A "great storm and tide" destroyed a large quantity of tobacco stored in various rolling houses (Chapman).

1667 September 6 (The "dreadful hurricane of 1667"): It appears likely this hurricane caused the widening of the Lynnhaven River. The Bay rose 12 feet above normal and many people had to flee.

This system is considered one of the most severe hurricanes to ever strike Virginia. On the first, this same storm was reported in the Lesser Antilles. The hurricane devastated St. Christopher as no other storm had done before. The "great storm" went on to strike the northern Outer Banks of North Carolina and southeastern Virginia. The wind turned from the northeast to due south and finally to the west, which suggested a track similar to the August 1933 hurricane, a benchmark storm for the Hampton Roads area in the 20th century (see page 33). This 1667 hurricane lasted about 24 hours and was accompanied by very violent winds and tides.

Approximately 10,000 houses were blown over. Area crops (including corn and tobacco) were beat into the ground. Many cattle drowned in area rivers and bays by the twelve foot storm surge and "many people had to flee." The foundations of the fort at Point Comfort were swept into the river. A graveyard of the First Lynnhaven parish church tumbled into the waters. Twelve days of rain followed this storm across Virginia. This system is blamed for the widening of the Lynnhaven River. Ships in regional rivers sustained great damage.

> Several accounts attest to the fury of this great storm. The first was published in London from Strange News from Virginia. Sir having this opportunity, I cannot but acquaint you with the relation of a very strange tempest which hath been in these parts (with us called a hurricane) which had began August 27th (September 6th Julian calendar) and continued with such violence, that it overturned many houses, burying in the ruines much goods and many people, beating to the ground such as were any wayes employed in the fields, blowing many cattle that were near the sea or rivers, into them., whereby unknown numbers have perished, to the great afflication of all people, few having escaped who have not suffered in their persons or estates, much corn was blown away, and great quantities of tobacco have been lost, to the great damage of many, and utter undoing of others. Neither did it end here, but the trees were torn up by the roots, and in many places whole woods blown down so that they cannot go from plantation to plantation. The sea (by the violence of the wind) swelled twelve feet above its usual height drowning the whole country before it, with many of the inhabitants, their cattle and goods, the rest being forced to save themselves in the mountains nearest adjoining, while they were forced to remain many days together in great want.

The tempest, for the time, was so furious, that it hath made a general desolation, overturning many plantations, so that there was nothing that could stand its fury.

The following is a letter from Secretary Thomas Ludwill to Lord Berkeley on the subject of this "dreadful hurry cane" of September 6th gives added information about the cyclone:

> Jamestown Colony - this poore country is now reduced to a very miserable condition by a continental course of misfortune. On the 27th of August followed the most dreadful Hurry Cane that ever the Colony (Jamestown) groaned under. It lasted 24 hours, began at North East and went around northerly till it came to west and so it came to Southeast where it ceased. It was accompanied with a most violent rain but no thunder. The night of it was the most dismal time I ever knew or heard of, for the wind and rain raised so confused a noise, mixed with the continued cracks of failing houses.....The waves were impetuously beaten against the shores and by that violence forced and as it were crowded into all creeks, rivers and bays to that prodigious height that it hazarded the drowning of many people who lived not in sight of the rivers, yet were then forced to climb to the top of their houses to keep themselves above water. The waves carried all the foundations of the Fort at Point Comfort into the river and most of furnished and garrison with it.....but then morning came and the sun risen it would have comforted us after such a night, had it not lighted to us the ruins of our plantations, of which I think not one escaped.

> The nearest computation is at least 10,000 houses blown down, all the Indian grain laid flat on the ground, all the tobacco in the fields torn to pieces and most of that which was in the houses perished with them. The fences about the corn fields were either blown down or beaten to the ground by trees which fell upon them.

The storm passed inland northeast of Jamestown into northern Virginia. A severe storm in Manhattan on the 8th was most likely a continuation of this cyclone, as it recurved northeast. Another hurricane may have passed very close to the Virginia coastline on September 10th since the "dreadful hurricane of 1667" was accompanied by twelve days and nights of rain. A second storm passing close to the Virginia coast would have extended the period of rain.

1669 August 18: This hurricane struck the northern Outer Banks of North Carolina, and most likely affected Virginia.

1683 August 23: A hurricane which made landfall in Virginia caused a tremendous flood in the Connecticut Valley.

1683 September 5-10: William Dampier, a sailor and buccaneer, gave a "vivid account" of a hurricane in the North Atlantic, three days after leaving Virginia. He addressed it in his chapter titled "Discourse of the Trade-Winds, Breezes, Storms, Seasons of the Year, Tides and Currents of the Torrid Zone throughout the World," published between 1703 and 1705. This writing became a classic of maritime literature (Ludlum).

1693 October 29: From the Royal Society of London, "There happened a most violent storm in VA which stopped the course of ancient channels and made some where there never were any." The great storm was violent as it passed through Accomack, which was located on the Delmarva peninsula between Chesapeake Bay and the Atlantic, sixty miles northeast of Norfolk. This storm may have created Fire Island Cut, to the east of New York City.

EIGHTEENTH CENTURY

1703 October 18: A hurricane caused great damage along the Mid-Atlantic coast. In Maryland and Virginia, many vessels left their moorings. Ten tobacco houses were overturned. Damage occurred northward to Philadelphia. Across the Northeast, northeast winds caused a very cold rain to fall. The timing of this storm was quite unusual, as it followed a very early season snowstorm by eight days.

1706 November 6: A severe storm raged offshore of Virginia before it swept up the coast. A fleet met the storm soon after departing the Virginia shore. Fourteen ships foundered on the north coast of Cape Charles; those ships that returned sustained extensive damage to masts and sails.

1713 September 17: A great storm attended by immense inundation affected the Carolinas and Virginia. The effects were most significant in Currituck county, North Carolina near the Virginia-North Carolina border, where the storm surge breached the Outer Banks and opened several inlets into the Currituck Sound. William Byrd, one of the commissioners who established the Virginia-North Carolina boundary, stated

"....There was no tide in Currituck until 1713, when a violent storm opened a new inlet five miles south of the old one, since which convulsion the old inlet is almost choked up by the sand, and grows narrowed and shallower everyday"

One of the new inlets carved out by the storm became the location where the Virginia-North Carolina line begins on the Atlantic coast.

1724 August 23 (Great Gust of 1724): Almost all tobacco and much of the corn crops were destroyed by a violent tropical storm, which struck Chesapeake Bay. "Violent floods of rain" and "prodigious gust of wind" were seen upon the James river. Some homes were wrecked and several vessels were driven ashore (Ludlum). One ship was wrecked while on the James river. It may have been followed by a second tropical cyclone on the 28th, as rains continued in Virginia for days.

1747 September 15: The next report of a hurricane in the area came twenty three years after the "Great Gust". A ship load of indentured servants, whose goal was to cross the Atlantic and pay for it with years of servitude, was lost in the Rappahannok river. She was struck just south of Urbanna by a "sudden violent hurricane" and immediately capsized. More than fifty drowned during the storm (Shomette).

1749 October 19: A tremendous hurricane tracked offshore Virginia, northeast to Cape Cod. At 1:00 a.m. at Norfolk, winds became violent from the northeast. The fury of the storm peaked between 10:00 a.m. and 2:00 p.m.. In Williamsburg, one family drowned as flood waters carried their house away. At Hampton, water rose to four feet deep in the streets; many trees were uprooted or snapped in two. Torrents of rain flooded northern Virginia and Maryland. The Bay rose to fifteen feet above normal...destroying waterfront buildings.

An account of this tremendous storm was given in the biography of Commodore James Barron, *An Affair of Honor*, by William Oliver Stevens. Barron's grandfather witnessed the hurricane first hand while stationed at Fort George. The account is as follows:

> A threatening sky was observed to the southeast over the Chesapeake Bay. The wind increased which soon brought the rain. As the hours wore on the wind and rain increased in fury. Sometimes the downpour slackened. One could hear the sand picked up by the wind from the beach outside and blasted against every object that still withstood the gale. All the while the rising tide was rapidly being piled up to a height never seen before in that area. The waves were pounding on the shore, finally to the very foot of the outside wall at Fort George. A large tree crashed over on its side with its roots in the air and was driven against the land side of the Fort. With the impact the wall yawned and broke. Shortly afterwards the seawall lurched and sank at the point where it was exposed to the wave fury of the storm. Finally the outside wall of the fort gave way, and the filling of sand poured out, leaving the inner wall exposed to the blast without support. When this too fell apart and collapsed, the barracks took the full force of the wind. About sundown, the storm slackened and in another hour the rain and wind had diminished to such a degree that it was clearly spent.

The next morning Commodore Barron swept the distant waters with his spy glass. He was astonished to see across Hampton Roads a wide, sand promontory which had not existed there before. A sand spit had been thrown up during the fury of the storm, which was the beginning of Willoughby Spit.

Another account of the storm given by a letter written at Annapolis, Maryland describes the storm as such:

"....On Saturday October 18th, the wind began to blow hard and by 1:00 a.m. (The 19th) was very violent from the northeast with rain. The hardest portion of the storm occurred from 10 a.m. to 2 p.m. on the 19th. The bay (Chesapeake) rose 15 feet perpendicular, according to one witness. The tide kept fluxing and ran some small craft nearly a mile from common high water and left some in cornfields.

At least four ships were destroyed at the south end of Chesapeake Bay (Shomette). Bodies washed ashore from the shipwrecks for days afterward. Damage in the area totaled £30,000...as currency of the colonies was British. Benjamin Franklin was keeping an eye on this one. It confirmed his hypothesis, the first of its kind, that storms along the coast moved from southwest to northeast (Ludlum).

1752 October 22: A storm caused great damage in southern Chesapeake Bay. Only one ship, named *Peggy and Nancy*, was lost during the northeast gale. She was driven ashore on Willoughby Point at 10:00 p.m.. The ship broke up in the morning; only the sails, rigging, and five of her original 338 hogsheads of tobacco could be recovered (Shomette).

1761 September: A hurricane of great strength raked the Virginia and North Carolina coasts. The schooner *Good Intent* was overtaken by the storm just after entering the Chesapeake Bay. This storm also carved a new inlet on the northern Outer Banks of North Carolina.

1761 October: A major hurricane brushed Cape Hatteras and remained east of the Virginia Capes.

1766 September 11: A hurricane struck the Virginia coast.

1769 September 7-8: Considered one of the worst storms of the Eighteenth century, this hurricane passed over Williamsburg. Winds increased at 1:00 a.m., blowing a violent gale between 10 and 11 a.m.. Winds increased out of the northwest and continued "until dinnertime". Many old homes and trees were leveled. Heavy rain ruined tobacco crops and flooded roads. Tobacco in storage was also damaged at the warehouse.

Heavy damage was seen in Chesapeake Bay. High winds tore off the top of a wharf at Yorktown; a schooner rammed a nearby storehouse. Four ships in the York river were driven ashore. Two ships on the James River were also wrecked. A vessel from Norfolk, filled with coal from Williamsburg, was forced up to Jamestown before it went to pieces. At least six perished due to shipwreck. The storm tracked northeast along the coast, accelerating as it passed by New England and into Canada.

1772 September 1: A tropical storm forced fourteen vessels ashore at Ocracoke Bar in North Carolina with 50 persons perishing. It is likely this storm caused significant winds in southeastern Virginia.

1773 August 26: The Virginia Gazette reported a storm in Virginia.

1775 August 29-September 2 (The Independence Hurricane): This savage hurricane raged from North Carolina to Newfoundland. Heavy rains began to fall across the colony on the 29th of August and slowly increased with time. The coast was ravaged from Currituck to Chincoteague. Wharves and storehouses on the waterfront of Norfolk were devastated. Bridges were carried away by the raging waters. At Williamsburg, mill dams broke and corn stalks were blown flat. Winds blew furiously until 10:00 p.m.

Many ships were damaged as they were thrown ashore at Norfolk, Hampton, and York. Around twenty-five vessels were run ashore, or "irrecoverable gone." The gun ship *H.M.S. Mercury* was driven hard aground on Portsmouth Point at 5:00 p.m. on the 2nd. It was stranded in two feet of water for eight days (Shomette). The *Liberty* became "hopelessly stranded" in Back River, near Hampton. A number of locals boarded her, captured the crew, secured her goods, and set the ship afire in the first outright act of war. A full blockade of Hampton Roads thereafter brought shipping to a halt for three months. At least twenty-five died due to shipwreck.

1776 July 10: A strong gale played a role in a battle between the Royal Governor of Virginia, Dunmore, and General Lewis of the rebel forces. The royal fleet had been injured prior to the storm by General Lewis' forces and was sailing from Gwynn's Island toward St. George's Island, in the Potomac. The British crew was without water and enduring smallpox when the gale struck.

A flour-laden supply ship ran aground. One ships foundered at the Mouth of the Rappahannock, while another was stranded on the Eastern shore (Shomette). The *H.M.S. Otter*, the Governor's ship, was rescuing another ship in distress. They were rescued just in time. After loading the distressed ship's cargo, the ship sunk. The governor later left Virginia for good on August 5th. Many ships in the area suffered damage to their rigging, sails, and anchors. Two vessels were driven ashore in St. Mary's county (Shomette).

1777 August 10: A storm of tropical origin affected the North Carolina and Virginia coasts.

1778 August 12: A hurricane passed quite near the Virginia coast generally on a track which extended from Charleston, South Carolina through New Bern, North Carolina and was next detected in southeastern New England. It prevented a major naval battle between the British and the French during the American Revolution.

1781 August 11: A gale prevailed for forty hours at Wilmington, North Carolina moving slowly northward just inside the coastline. This storm probably affected Virginia as well.

1781 October 16: A storm of "unknown character" struck Virginia. The Earl of Cornwallis, at Yorktown, was trapped by the French Fleet and the Patriot Army, under the command of George Washington. The Earl decided to flee to the north to Gloucester Point under the cover of darkness. A "furious storm" doomed the plan to failure, as seas ran high and every boat was "swamped". He sent forward his flag of truce and surrendered, thus ending the battle (Chapman).

1783 October 8: The first of three major storms to affect the East coast that month made landfall near Charleston on the 7th. At Richmond, violent winds blew in from the northeast for 24 hours. Norfolk saw a 25 foot rise in the tide, which caused damage there and at Portsmouth totaling around £9000. The reference to 25 foot tides was probably more of a reference to wave heights. This cyclone moved offshore New Jersey and continued past Providence, Rhode Island.

1785 September 22-24: The "most tremendous gale of wind known in this country" passed over the Lower Chesapeake Bay and went along a track very similar to the Chesapeake-Potomac Hurricane of 1933. At Norfolk, lower stories of dwellings were flooded. Warehouses were totally carried away by the storm surge, causing large amounts of salt, sugar, corn, and lumber to disappear. A large number of cattle drowned, and people hung onto trees for dear life during the tempest. At Portsmouth, the entire town was submerged. Forrest's book, Sketches of Norfolk, offers this account of the storm:

"....This year, 1785, was noted for the highest tide ever before known to Norfolk, completely deluging a large portion of its site on the water side".

Almost all ships in the area were driven from their moorings near Norfolk. Many ships were dismasted as well. The brig *Nancy*, coming from Madiera with a cargo of wine, was dashed to pieces on the Virginia Capes. Only two aboard survived the ordeal. The sloop *Phobe* lost its bowsprit and was laid upon her beam ends. A Dutch ship was found fully loaded, with no one aboard. Vessels floated inland into cornfields and wooded areas. No less than 30 vessels were seen beached after the storm. Damages totaled £30,000. At least two died due to shipping disasters. After ravaging Virginia, the system tracked up the coast to Boston.

1788 July 23-24 (George Washington's Hurricane): This storm originated near Bermuda on the 19th before making landfall in Virginia. It passed directly over the Lower Chesapeake Bay and Mount Vernon, the home of George Washington. This track is very similar to the track of the Chesapeake-Potomac hurricane of 1933. At Norfolk, winds increased at 5 p.m. on the 23rd with the wind originating from the northeast. At 12:30 a.m., the wind suddenly shifted to the south and "blew a perfect hurricane, tearing down chimneys, fences"...some corn was also leveled. In addition, large trees were uprooted and houses were moved from their foundations.

Port Royal and Hobb's Hole experienced a violent northeast gale which drove several vessels ashore. In Fredricksburg, great quantities of corn, tobacco, and fruit were destroyed. Houses and trees fell in great numbers across Northumberland, Lancaster, Richmond, and Westmoreland counties. Crops were destroyed and many livestock perished in Lower Mathews county. Many plantations saw their houses leveled. Homes were flooded with water six feet deep... several inhabitants drowned. Gloucester county was inundated, $400,000 in damage was incurred.

Historical figures of the time logged the storm's antics. George Washington noted the sinking of the small ship *Federalist* and uprooted trees. Colonel James Madison, father of the future president, experienced the passing of great winds and rains near Orange. In Alexandria, damage to wheat, tobacco, and corn was "beyond description" (Ludlum).

The schooner *Patriot* was stranded and bilged near Portsmouth. The schooner *Serenity* was driven aground at the Portsmouth distillery, proving a total loss. A newly constructed brig, most likely the *Neptune*, was lifted up from here moorings and left in the main street of town. The *Mermaid* was dismasted. The *Favorite* was completely destroyed at Hampton Roads...only two ships in Hampton Roads escaped the hurricane. Many small craft were "torn to pieces".

1795 August 2: A hurricane which passed through North Carolina passed to the south of Norfolk. A ship foundered off Cape Charles. Heavy rains in northwestern Virginia flooded Winchester and Martinsburg. Roads were impassable beyond Baltimore, disrupting mail service. A large amount of corn and hay were in ruin. Mills and mill dams were swept away. Great damage was noted across Culpeper and Orange counties. It then recurved across Maryland and passed south of New York City to Halifax. Several vessels were lost off Norfolk. The brig *Esther* was lost, with most of her cargo from Jamaica, twenty-five miles south of Ocracoke Bar.

1795 August 12-13: A major hurricane...only ten days after the previous storm...struck North Carolina and produced high winds as far inland as Winston-Salem. At Monticello, near Charlottesville, Thomas Jefferson noted that the loss of soil from the heavy rain thus far that month could be "modestly estimated at a year's rent" (Ludlum). A "powerful torrent of rain" deluged Petersburg; creeks were at their highest point of the past 70 years.

1797 September 5-6: A sloop was lost at Currituck Inlet on the 5th during a storm. The sloop *Betsy* was returning from Cape Hatteras during the 6th. In sight of the Cape Henry lighthouse, she "was obliged to bare away in a gale of wind" (Chapman).

NINETEENTH CENTURY

1803 August 29: The schooner *Jupiter* sprung a leak off the Virginia Capes in heavy seas during a storm off the Virginia Capes, before heading into the Chesapeake. As the ship was sinking, the captain jumped overboard, but was pulled into the whirlpool created by his sinking ship and drowned (Chapman).

1804 September 8 (Antigua-Charleston Storm): This system was first spotted near the Northern Leeward Islands on the 3rd and moved west-northwest, to very near the Florida coast. It then moved inland near Charleston with disastrous consequences, before moving northeast along the coast of the Atlantic Seaboard.

1804 October 9 (New England's Snow Hurricane of 1804): At Norfolk, winds shifted from Force 3 southwest (on the Beaufort scale) to Force 6 northwest by 2 p.m.. A schooner *Rising Stakes,* off Cape Henry, went through the "dreadful squall" at 11 a.m.. The system passed through Chesapeake Bay, then inland between Philadelphia and Atlantic City before moving onward to New York City and Boston. Eight perished offshore.

As it passed through the Northeast, it became a nontropical low as cold air rapidly enveloped the circulation of the cyclone. Snow fell from the hills of Connecticut northward into Canada. As much as 24 to 30 inches of snow fell in the Berkshires of Massachusetts...which in a wet snow could be approximated to six inches or more of liquid precipitation. This was the first reference to snow involved with a landfalling tropical cyclone, but not the last, as the reader will see later on in this history.

1806 August 21-23 (Great Coastal Hurricane of 1806): The appearance of the weather from the 20th indicated a nearby storm. Heavy squalls broke upon the bar off Norfolk. A hurricane which went inland in South Carolina took 36 hours to go through North Carolina. The system accelerated into the offshore waters of Virginia.

A gale developed out of the north-northeast on the 22nd before noon. At Norfolk, the wind blew with "great violence" out of the north between midnight and 3 a.m.. A considerable amount of rain fell. A "long and uncommon" drought in Petersburg was ended by the cyclone (National Intelligencer). This saved the corn crop. Several new buildings and chimneys were blown down. Two vessels were grounded.

The hurricane caught British and French ships off guard, while engaged in the Napoleanic Wars in the U.S. shipping lanes. The British man-of-war *L'Impeteax* drifted under jury masts for 23 days before finally beaching near Cape Henry. The ship *Atlantic* and brig *Martha Bland* were driven ashore. The vessels *Haleyon, Hope,* and the Revenue cutter schooner *Eagle* went ashore at James Island.

Ships of the two warring nations put in for repair and refitting at the port of Norfolk after the storm. This hurricane, due to its slow movement and consequent erosion of the coastline completed the creation of Willoughby Spit. A seawall built to prevent further erosion at Smith Point lighthouse was damaged.

1806 September 28-29: The first signs of the system were seen in Georgia, when several days of heavy rain fell at Augusta, Georgia on the 25th (National Intelligencer). Gales began from the northeast during the night of the 28th at

Norfolk. Winds became southeast in the morning before shifting to the west, as the center moved inland of the coastline. Tides rose "uncommonly high". The schooner *Charming Mary* fell victim four leagues north of Chincoteague, with many of her masts seen above the waterline after her sinking (Chapman).

1808 September 12: A hurricane again damaged the seawall surrounding Smith Point lighthouse. The ship *Mary* was destroyed during the gale, while anchored at Baltimore.

1813 August 27-28: A hurricane struck Charleston and spread gale force winds as far north as Maryland. An all-day easterly gale was seen in the Upper Chesapeake Bay on the 28th. A north-northeast wind began on the 27th. By 10 p.m., it shifted to southeast, accompanied by squalls. As winds became southwest, strong winds buffeted the region until 1 a.m. the 28th. By 11 a.m., winds were dying and the sun was shining once more. The U.S. schooner *Carolina* went ashore near James Island.

The War of 1812 was in progress. A large prison ship, with 50 passengers aboard composed of the British schooner *Dominico,* parted cables and was driven into the marsh of James Island by the gale (Chapman).

1814 August 24-25 (Burning of Washington): A very hot day accompanied the retreating of Federal troops from the Capitol. As Dolly Madison and an armed escort stopped in Tennallytown (Tenlytown) during their retreat, a strong wind accompanied by dark clouds rolled over Washington county. Winds near hurricane force and a prolonged downpour added to the drama of the day. The rains were helpful, as they helped firefighters quench the fires set by the British (Helm). The weather signs mentioned point to this either being a severe thunderstorm, or a tropical cyclone.

1815 October 24-26: On the 18th, a powerful hurricane struck St. Bartholomew in the Caribbean Sea. By the 24th, it progressed west and northwest to a position east of Chesapeake Bay. The schooner *Friendship* was knocked on her beam ends by unfriendly winds and seas. For 48 hours, the storm passed offshore, delaying ship arrivals into Norfolk with its strong northwest wind (Chapman).

1816 September 18: A tropical storm affected Virginia before moving northeast into New York. Heavy rains caused the James river in Richmond to rise only an inch or two lower than the High Fresh of 1814. Flood waters invaded the first floors of area homes. One bridge was submerged, cutting off travel (Chapman).

1817 August 8-9: A tropical storm with heavy rain moved through the state. At Norfolk, floods to the north delayed the passage of mail. The gale moved slowly northeast, reaching New York on the 12th. (Chapman)

1821 September 2-3 (Long Island Hurricane): One of the most violent hurricanes on record. A fast moving hurricane traveled from Puerto Rico to Norfolk in only two days. The storm passed by Turks Island in the Bahamas on the 1st. This hurricane moved inland near Wilmington, North Carolina the following day. The center then tracked west of Ocracoke but east of Edenton. In Currituck, N.C. all but a half dozen houses were destroyed and several people killed.

It was a "tremendous storm", causing great wind damage and damaging ships in the harbor. At Norfolk, rains began at 6 a.m.. By 8 o'clock, a northeast gale ensued and increased in intensity to hurricane force by 11:30. By 12:30 p.m., rains ended; conditions were beautiful by mid afternoon. An account from the *Norfolk Herald* described the storm as such:

> From half past 11:00 until half past 12:00, so great the fury of the elements, that they seemed to threaten a general demolition of everything within their reach. During that period the scene was awful. There was the deafening roar of the storm, with the mingled crashing of windows and falling of chimneys, while the rapid rise of the tide threatened to inundate the town. The continuous cataracts of rain swept impetuously along darkening the expanse of vision and apparently confounding the heaven, earth and seas in a general chaos; together with now and then a glimpse caught through the gloom, of shipping forced from their moorings and driven with rapidity, as the mind might well conjecture in such a circumstance to inevitable destruction. (Ludlum).

Trees were uprooted. Part of the front of the Episcopal church was blown in; its organ left in ruin. The courthouse was partially unroofed. Several new homes suffered complete destruction while many others experienced damage. The new stone bridge on Granby Street was damaged by the incessant banging of heavy timbers against it. The tides inundated the ground floors of all the warehouses on the wharf lining the Elizabeth River. The waters surged as far inland as Wide Water Street some several hundred yards from the river. The surging waters of the Elizabeth River swept away the bridge on Catherine Street. The drawbridge across the Elizabeth river was swept away. The U.S. Frigates *Congress* and *Gurriere* were grounded while numerous other brigs, schooners, and smaller ships suffered an untimely demise.

Crops were destroyed in the vicinity of Chesapeake Bay. At Chincoteague, waters surrounding the island were evacuated such that miles of sandbars lay exposed to the air, as winds were initially offshore. The following is an account of what happened next from Howard Pyles, written in 1876:

> "...then a dull roar came nearer and nearer, and suddenly a solid mass of wind and rain and salt spray leaped upon the devoted island with a scream. Great pines bent for a moment, then, groaning and shrieking, were torn from their centuried growth like wisps of straw and hurled one against another; houses were cut from their foundations and thrown headlong; and then a deeper roar swelled the noise of the tempest, and a monstrous wall of inky waters rushed with the speed of lightning toward the island. It struck Assateague, and in a moment half the land was a waste of seething foam and tossing pine trunks; and the next instant it struck Chincoteague, and in an unbroken mass swept away men and ponies like insects; rushing up the island, tearing its way through the stricken pine woods." (Barnes & Truitt)

At Pungoteage, a ten foot storm surge led to "unexampled destruction". Damage spread north with the storm into New York and New England over succeeding days. It was considered one of the most violent hurricanes on record... with damage totaling $200,000 in Virginia. Five drowned at Chincoteague.

1822 September 27-28: This hurricane struck Charleston, then moved through central North Carolina and western Virginia, accompanied by a "tropical deluge". Richmond had endured a long drought until this storm visited the region. "Very copious rains" and "equinoctial winds" quickly ended the drought. Flash flooding occurred on the James River, rising feet in depth in a matter of one hour (Washington Gazette). Mail south of Richmond was unable to be delivered for three days, as the storm rendered roads impassable. At Monticello, near Charlottesville, Thomas Jefferson's granddaughter noted that a violent storm broke branches and felled one of their willows. At Lynchburg, winds uprooted trees and toppled chimneys. Along the Staunton River, rains began on the 27th and continued until 9 a.m. the next day. The river rose to "the greatest height ever known" (Chapman).

1825 June 3-4: Forming before what is nowadays considered as the beginning of the hurricane season, a severe tropical storm tormented the Atlantic seaboard from Florida to New York City. It was first sighted near Santo Domingo on May 28th and moved across Cuba on June 1st. Gales began at St. Augustine as the cyclone approached U.S. soil on the 2nd, and at Charleston on the 3rd.

It raked Norfolk with "undiminished violence" for 27 hours from the morning of the 3rd, as the storm passed by to the east. The wind came in "flaws". Trees were uprooted. At noon on the 4th, stores on the wharves were flooded up to five feet in depth. High winds howled through Washington D.C.. Along with a cold rain, winds leveled crops. The storm then moved northeast past Nantucket on the 5th.

An account of the storm was given by Ann Waller Tazewell, wife of the then governor of Virginia in a letter to her son. She describes the storm as such

> "....The rain commenced on Friday morning (3rd), and continued pretty steadily all day, at night the wind blew so hard that this house rocked considerably. I was so much alarmed as to be unable to sleep but very little - I thought of my flowers, but could not expect anyone so much as to look after my cows or anything, as the rain fell in torrents, and the wind came in flaws, which made it like thunder yesterday (4th) the storm continued until five in the evening, there was a strong northwest wind all day, and the highest tide I ever saw in my life. The wind and tide together tore down all our enclosures at the other lot, upset our cow-house and then dashed it to pieces, tore up some of the wharf logs, upset the Temple there, and drifted it into the flower garden........We sat at the front windows witnessing the destruction all the time it was going on. Our front lot was two thirds covered by the tide. Some vessels that we saw pass rapidly by, were driven ashore at the Hospital Point (Portsmouth)........"

Ann Tazewell later compares the storm to the great gale of September 1821 in this following passage: "....Such a storm was never experienced here before, by anyone that I have heard speak of it. It is thought to have been far worse than the September gale of 1821." Mrs. Tazewell's letter also mentions that they could not prepare dinner since the tide level was even with the kitchen floor.

An account of the storm as given by the Norfolk and Portsmouth Herald described the storm as such. It is interesting to note the contrasting opinions between the Norfolk and Portsmouth Ledger and the letter from Mrs. Tazewell regarding the comparisons between this storm and the September gale of 1821

> .....It is uncommon to hear of violent storms and hurricanes on any part of our extensive coast in the month of June; but we have to notice a visitation of stormy weather, which commenced about 9 o'clock on Friday night (3rd), rarely if ever equaled within the life span of the oldest inhabitant. The storm of the 3rd of September 1821 was perhaps more violent but it only lasted three or four hours, while this storm continued with undiminished violence, from the hour we have stated until 12 o'clock on Saturday night (4th), or about 27 hours. The wind at the commencement of the storm was northeast and so continued until about 12 o'clock on Saturday, when it began to haul gradually to the northwest and westward, and held up at southwest....

According to this account, the tides in this storm were higher than those in the September gale of 1821.

> ....considerable damage was done by the high tide which rose at least eighteen inches higher than it was known to be within the last forty years. The highest pitch of the tide was at 12 o'clock on Saturday, at which time the stores on the wharves generally were inundated from the depth of three to five feet, and the water extended up to the doors on the north side of Wide Water Street. The whole Town Point to within a few feet of Main Street was over-flown, as also was that part of town extending eastward from Market Place to the Drawbridge, the water rising considerably above the line of Union Street. In most of the stores on the wharves, all articles liable to be damaged by the tide were found (too late for remedy) that the precaution was unavailing in consequences of the unusual rise of the tide, and the articles were of course damaged....

1827 August 24-27 (St. Kitts Hurricane): A hurricane originating near the Windward Islands struck Cape Hatteras, before moving northeast offshore Virginia, Maryland, and New England. The track of this storm was to the east of Norfolk. Initial reports from Wilmington, N.C. indicated that this was a storm of great intensity as it passed by to their east. One report gave an account of waves over the top of garden fences some 6900 feet from the beach. Other reports indicated storm tides greater than 10 feet above normal levels. The town of Washington,. North Carolina, on the western end of Pamlico Sound, reported water levels 12 to 15 feet above ordinary levels.

The following first hand account of this storm in Virginia was from the Tazewell Papers in the Virginia State Library. Henry Tazewell wrote to his brother John in New York and described the storm as such.

"....A severe gale which continued for three days changed the climate here entirely and persons are clad generally in full suits of winter clothing; the same gale has done great injury to shipping and to present crops. The fodder is worthless and the corn in many places is much broken by the wind."

The Norfolk newspapers, The American Beacon and The Norfolk Herald reported little in the way of tidal damage in this storm due to an ebb tide. There was much less damage to property in the area than in the memorable 1821 gale, but this storm was almost as violent as that gale.

Both papers reported a gale of wind which was accompanied by a copious fall of rain. The gale

"...commenced in the forenoon of August 25th and continued to increase until the evening, when it blew tremendously. About midnight, the rain ceased and the gales somewhat abated, though it continued to blow fresh all day on the 26th."

At the height of the storm, winds unroofed a two story building on Talbot street in Norfolk and commenced to blow away the second floor of the building. Livestock was swept away in large numbers. Corn was leveled at Belleview...a mill dam was torn to shreds and the bridge over it was swept away. The sloop *Flag* capsized on the Middle Ground of the Chesapeake; the vessel had no survivors. The brig *Liberty* of Boston broke away and drove itself ashore, on the south side of Portsmouth. The schooner *Mulberry* saw its bow stove in, shrouds and jib-stay carried away, and jib torn off while off Common's Marshes. A "considerable quantity" of cargo was thrown overboard to prevent it from sinking. "Considerable mischief" was caused by the tempest as far north as Baltimore.

1829 August 26-29: A tropical storm of considerable strength moved northward through eastern North Carolina and Virginia, accompanied by a tornado near Sunbury, North Carolina in Gates County. Torrential rains were reported in Norfolk. At Georgetown, the rice crop experienced great injury. Santee also saw damage. A vessel fifty miles east of Chincoteague was dismasted. The American Beacon reported the following account from this storm.

"....The earth is completely saturated and the grounds covered in water, while the roads, in many places, are rendered impassable by the rise of the water courses." (Chapman)

1830 August 16-18 (Atlantic Coast Hurricane): This hurricane passed northeast of the Caribbean Sea and tracked west north-west to a point very near Daytona Beach, Florida before recurving to the north and northeast. The center made landfall on the morning of the 16th near Cape Fear and moved back out into the Atlantic by nightfall. The area's three-month drought came to a sudden end. Complete damage was done to corn crops as a considerable amount of rain fell.

A number of ships that arrived at Alexandria on the 22nd spoke of a severe gale on the 18th...one lost its topsail. The schooner *Dove*, while thirty miles east of the Virginia Capes, experienced a severe hurricane and lost most of her upper works. On the morning of the 19th, an empty ship in full sail was seen just off the Virginia coast.

1833 August 24: As a rare act of foreshadowing, a northeast gale detained around 100 vessels at Norfolk. This system passed well off of the Virginia coast. Unlike the storm exactly a century later, no damage was reported (Chapman).

1834 September 5: A hurricane that struck the North Carolina coast also created problems for Virginia. A "severe" northwest wind capsized the schooner *E. Pluribus Unum*, laden with stones. The crew escaped with their lives. The schooners *Susan* and *George Wheaton* bumped into each other at Newport News. The *Susan*'s upper work was carried away (Chapman).

1837 August 18-20 (Calypso Hurricane): A hurricane which skirted the North Carolina Outer Banks also affected Virginia. Damage was considered lighter than at Wilmington, where bridges washed out during the storm. This was referred to as the worst storm in Norfolk since 1822. The storm was observed east of the West Indies on the 13th, moved into the central Bahamas on August 16th and began to affect the North Carolina coast on the 18th, where the Norfolk newspapers reported it had continued with unusual severity for forty-eight hours.

The *Norfolk-Herald* offers this account of the storm.

> "....One of those cracking northeasterly blows commonly called "September gales" which, however, more frequently visit our coast in August commenced here on Saturday the 19th, but as our harbor is completely sheltered "land-locked", we believe the sailors call it, none but the weather-wise had any idea that it was blowing a gale outside, until 11 o'clock at night, when the symptoms of a regular-built gale were easily recognized in the roar and rustle which it kept up, and the splashing of the torrents of rain which it drove before its streamed flows. This strife of elements continued until 12 o'clock Sunday the 20th, when the wind hauled around to the northwest but without clearing off and continued to blow a heavy gale from that point, accompanied with rain the remainder of the day."

The *American Beacon* offers this account of the storm.

> "....The weather on Saturday morning (19^{th}) indicated a gale. It commenced raining that morning and continued but with little intermission, until about 3 p.m. the next day. The wind blew fresh from the northeast all day Saturday, and at night increased to a gale, blowing down fences, trees, chimneys and prostrating the corn....In walking the streets after the storm, it was melancholy to see some of the stoutest trees prostrated. The tide is very high."

1837 October 8-9 (Racer's Storm): This hurricane was named after the British sloop-of-war, the *H.M.S. Racer*, which encountered it on September 28^{th} in the central Caribbean Sea. It was the tenth known storm of that destructive season. After moving northwest into the far western Gulf of Mexico, the storm slowly recurved along the coasts of Texas and Louisiana before it struck Venice, Louisiana on the 7^{th}.

The system then passed back out into the Gulf before making a second landfall near Pensacola late on the 7^{th}. The storm moved northeast and went off the East Coast near Wilmington late on the 9^{th}. Norfolk experienced a northeast gale on the 8^{th} and 9^{th}. This prevented steamboats from leaving their docks.

1839 August 29-30: A tropical cyclone which struck Charleston on the 28^{th} passed through eastern North Carolina on the 29^{th} and then Norfolk just past midnight that night. The hurricane raged until 3 p.m..

1841 October 3-4: An intense hurricane raced through the shipping lanes offshore the Mid-Atlantic. On the western fringe of the cyclone, several ships were beached at Cape Henry. The system went on to devastate eastern New England, when cold air encircling the increasingly nontropical storm led to "a violent storm of snow and sleet" at New Haven, Connecticut.

1846 September 8: This hurricane created Hatteras and Oregon Inlets.

1846 October 12 (Great Havana Hurricane): The Great Havana Hurricane struck the Florida Keys with great violence before moving northward, inland of the Eastern seaboard. It destroyed the Old Key West lighthouse; fourteen inside the structure perished (DeWire). The Potomac at Alexandria and Washington D.C. reached its highest heights in 20 years. Tides at Washington, D.C. rose to 6.9 feet above low water datum. Extensive damage was seen as far north as Baltimore, Philadelphia, and New York.

1850 July 18: The first of three hurricanes to affect the upper Eastern Seaboard moved into North Carolina on the 18^{th}. As it moved north, Chesapeake and Delaware Bays took a beating as high waves and tides flooded the coast. It moved almost due north into central New York state.

1850 August 24: A powerful Gulf hurricane struck Apalachicola on the 24^{th}; a great storm surge inundated the northeast Gulf coast. As the system moved north, enormous amounts of rain fell from Georgia northward to Virginia. Major flooding occurred along numerous rivers. The Dan rose to a level twenty feet above normal. The cyclone continued northeast, causing damage in its wake through New England (Barnes II).

1851 August 24-25 (Apalachicola Storm): A hurricane moved across the Greater Antilles past western Cuba on the 22^{nd}, then moved north to strike Apalachicola with a high storm surge on the 23^{rd}. Thereafter, the storm tracked through Georgia and the Carolinas, moving into northern Chesapeake Bay on the night of the 24^{th}.

High southeast gales made it the worst storm in thirty years for the region. The wheelhouse of the *Osceola* was torn away and blown overboard. Crops and small buildings were leveled. The system continued moving northeast offshore Nantucket, before making its final landfall in Nova Scotia.

1854 September 7-9: A very destructive hurricane swept the East Coast from Florida to New York. Norfolk experienced the force of the storm on the 9^{th}.

1856 August 19 (Charter Oak Storm): This weather disturbance was first noted in Virginia. Washington D.C. had east and southeast winds throughout the day, accompanied by heavy rain.

1856 September 1: This storm went through the interior of the Southeast before affecting Virginia. At Norfolk, the gale was considered an equal of the 1846 hurricane. It began at 4 a.m. and raged throughout the day. The spire of the Baptist church was blown off. A twenty year old tree met an untimely fate at Portsmouth. Much damage occurred at the Navy Yard.

1861 October 28 & November 2 (Expedition Hurricane): Occurring during the first year of the Civil War, an expedition by "the largest fleet of war ships and transports ever assembled" started at Fortress Monroe, inside the entrance of the Chesapeake Bay. As the ships were assembling, high winds and gales played havoc with their coordination, just prior to setting sail. The fleet was hit by another storm on November 2nd. Two vessels were sunk off the Carolina Capes. This second system continued northeast to Boston by late that day.

1872 October 25: A storm from the Gulf of Mexico moved across North Florida, before striking Charleston and moving up the Appalachians. Very heavy rains of four to eight inches drenched areas around Norfolk, with the 6.29" on the 24th at Norfolk setting a daily rainfall record.

1874 September 28-29: This hurricane struck southern North Carolina. It entered Virginia west of Norfolk. It was the first hurricane ever represented on a weather map (Barnes II).

1875 September 18-19 (Indianola Hurricane): The first of a series of hurricanes to end Indianola, Texas' reign as one of the leading ports in Texas, this system tracked through the Caribbean and Gulf of Mexico before striking the unlucky port on the 16th. The storm made a sharp right-hand turn through the Southeast, re-emerging into the Atlantic on the morning of the 19th in the vicinity of Chesapeake Bay.

1876 September 16-17: This hurricane moved over the Greater Antilles, and recurved just off the coast of West Palm Beach, before finally coming ashore near Cape Fear. As the system tracked through Interior Virginia, it brought a five minute sustained wind of 78 mph to Cape Henry and dumped 8.32" of rain. The 7.18" that fell on the 16th set a 24-hour rainfall record for September. High tides were seen at Washington D.C., when the level rose to 7.9 feet above low water datum. Average 5 minute wind speed at Cape Henry was 78 mph.

1877 October 3-4: A storm was first seen near St. Vincent and Grenada in the eastern Caribbean Sea...the island of Curacao was devastated. The hurricane then moved through the Caribbean Sea and the Gulf of Mexico before making landfall at Panama City Beach, Florida. It then moved north and northeast across the Carolinas, before moving out to sea near Norfolk. During the year 1877, tropical storms accounted for eleven inches of rain in the Norfolk/ Hampton Roads area.

After causing extensive flooding across North Carolina, heavy rains established floods of record. Along the James river, Lick Run (33 feet), Buchanan (34.9 feet) and Cartersville (30.4 feet) ran well above flood stage. Washington, D.C. set a 24-hour rainfall record for the month of October when 3.98" fell on the 4th. Many ships were wrecked all along the Atlantic coast, Chesapeake, and Delaware Bays. The cyclone continued northeast towards Newfoundland.

1878 September 12: As this tropical cyclone moved through the Caribbean, hundreds of lives met an untimely end. It tracked west, then northwest, moving due north from the Florida Keys to Lake Erie thereafter. Five significant tornadoes were recorded (Watson). At 1 p.m., the first tornado touched down southeast of Petersburg. The second tornado in Dinwiddie county was more destructive as it moved through Ford's Depot. Trees were leveled, while small homes and a barn were destroyed. Other tornadoes wrought havoc in Henrico county, Nottoway, and Goochland. The Goochland tornado tracked 28 miles after it descended around 4 p.m. (Watson). A great many ships were disabled and wrecked.

1878 October 23 (Gale of '78): One of the most severe hurricanes to affect eastern Virginia in the latter half of the 19th century struck on October 23, 1878. This hurricane moved rapidly northward from the Bahamas on October 22nd and struck the North Carolina coast late that same day moving at a forward speed of 40 to 50 mph. The storm continued northward passing through east central Virginia... Maryland and eastern Pennsylvania. To find out what it did to the Eastern Seaboard, check out the Gale of '78 website.

Winds began to freshen at midnight, reaching gale force at 2 a.m.. Immense waves broke over the upper deck of the steamer *Express*. Winds reached hurricane force at 4 a.m.. The ship then wandered through the middle of Chesapeake Bay. The barometric pressure fell to 28.78". The five minute sustained wind reached 84 mph at Cape Henry. At 5 a.m., waves tore away the saloon deck and flipped the ship on her side. After rolling completely over, survivors gathered timber to make a tiny escape craft. It sank immediately. The Quartermaster was rescued at noon that day, twenty miles from the scene of the wreck. The weather map above is from just after the time of the shipwreck, reconstructed from the original U.S. Signal Service data, obtained from the Library of Congress.

The steamboat *Shirley* was driven ashore Barren Island. A schooner in Chesapeake Bay was reported to have drifted into the woods. Cobb and Smith Islands were completely submerged during this storm. The *A.S. Davis* went ashore at Virginia Beach, killing 19. At least 22 ships met their demise in this hurricane.

Damage from this hurricane was widespread along the East Coast. Many of Virginia's life saving stations were damaged, with one lifted from its foundation and moved half a mile. An account of the storm's effects in the Norfolk area was provided by the Norfolk Landmark.

> "....Only strong willed people could sleep while dwellings so violently oscillated with the ravings of the tempest Tuesday night (22nd). At an early hour a severe gale sprung up from the northeast and by 9 o'clock old Boreas was knocking things around town in a lively style. The rain came down in torrents and the streets at times were a driving sheet of water. Yesterday morning (23rd), after the abatement of the storm it was found that considerable damage and loss was involved in the destruction of various sorts of property around the city and vicinity. The maddening fury of the elements will long be remembered as making one of the most severe storms in the annals of our city's experience...."

There is another first hand account of the storm from Mr. Bolton, an employee of the U.S. Signal Service, an early version of the National Weather Service. Mr. Bolton was a repairman of the telegraph line between Cape Henry and Kitty Hawk and was stationed at the Life Saving Station No. 3 in False Cape.

> "....I was at the station when the gale, which proved so disastrous to human to human life commenced. A severe rain storm has prevailed all day Tuesday (22nd) but the gale did not reach the station until 9 p.m. It rapidly increased in velocity until it almost became a hurricane. The members of the crew at this station, whose duty it is to patrol the beach that night, performed their duties with the upmost difficulty, as they could scarcely make any headway against it, and often had to cling to some stationary object like a telephone pole to prevent themselves from being carried away at the mercy of the fearful tempest..."

Mr. Bolton described the wreckage of the ship *A.S. Davis*, which had sunk off of present day Virginia Beach.

> "....The debris was thickly scattered along the beach for a distance of fully 4 miles....I proceeded to Cape Henry, Virginia to assist the Signal Officer there. The body of one of the crew was there. About 1 ½ miles south of Cape Henry the bodies of eleven of the crew had been washed ashore.....During the heaviest part of the gale, the wind at Kitty Hawk, North Carolina registered 100 mph. The instrument itself was finally blown away and therefore no further record was made. It was the severest gale that had occurred on this coast for sometime."

1879 August 18: An extreme hurricane moved north and went on the rampage from the Bahamas to Eastport, Maine (track to the right). In the immediate Mid-Atlantic region, the track of this storm ran very close to a Wilmington - Elizabeth City, N.C. axis to just southeast of Norfolk. It was considered one of the most severe to strike coastal Virginia in the last half century and was probably as severe as the June 1825 storm.

The passage of this storm was accompanied by a rapid pressure fall from 29.58 inches at 9:00 am to 29.12 inches at 11:15 am on the 18th, which was the lowest pressure observed in the storm. Five-minute sustained winds rose to 76 mph with gusts toward 100 mph at Cape Henry, before the anemometer was destroyed. The tide at Norfolk rose to 7.8 feet above mean lower low water. Dozens of ships were damaged from the Carolinas northward to Cape Cod. The rainfall from this storm was one of the heaviest in the history of Norfolk, 6.17 inches, with 6.03 inches falling on the 18th...of which 5.13 inches fell in just over 9 hours. On the next page is a chronology of Observations taken at Norfolk, Virginia during the August 1879 hurricane.

The Norfolk Virginian described the "red-letter" storm in the following account.

> "....Yesterday (18th) was one of the red letter days in Norfolk's history. It was the occasion of one of the severest storms which have ever visited this section. The severity of the wind and the extent of the rains were such as have never been experienced in Virginia, and we doubt if the hurricanes of countries subject to such inflictions as visited Norfolk yesterday, have ever suffered to a greater extent from the ravings of the storm than did our city for a number of hours.....
>
> ....In the early morning the wind blew from the northeast with a strength which betokened a settled rain storm and gave everyone acquainted with our climate to understand that a bad day and heavy blow was to be expected. As the day wore on the wind became more boisterous....
>
> ....At about ten o'clock the wind had gained such strength that it was dangerous to appear on the streets, while the rain fell in such torrents that it was most disagreeable to do so.....the wind swept along with prodigious strength while the rain fell in torrents, which inundated wharves, streets and the lower floors of a number of buildings. About eleven o'clock it had reached its height, and dealt destruction on every hand. Roofs were blown off houses, trees were up-rooted, wharves destroyed and other injuries to properties inflicted....
>
> ....Water street was inundated and boast were to be seen on the water from the western terminus to Market Square. It is almost impossible to describe the appearance of the city at that time, with its frightened inhabitants running to and fro, the debris scattered along the streets and the wind playing havoc with the signs, trees, roofs, etc.

Several ships had run aground in the harbor between Norfolk and Portsmouth. The steamer *N.P. Banks* was run aground not on the flats of the Norfolk Naval Hospital (in Portsmouth) but on the very grounds of the hospital itself due to the excessive tides. The ferry boat *Berkeley* filled and sank in her dock on the Berkeley side of the river. The schooner *John C. Henry* foundered off Gwynn's Island.

The storm was described in Portsmouth as the most terrific storm to have visited the area in many years. From the Norfolk-Portsmouth Herald:

> "....As early as 3 a.m. the rain began to fall in torrents, and the wind rising about the same time, increased in violence until it reached its height between 10 o'clock and noon. To those on shore and in a safe place, if such a place can be found, it was indeed a terrifically grand sight, one not often seen in this harbor, and seen once suffices a life time. The high wind brought in the waters of old ocean, wave piled upon wave until our wharves were submerged, our streets flooded and converted to many places to temporary canals, the tide being the highest ever known. On the waterfront exposed to the full play of the wind and wave, the sight was best seen. At the northward of North Street the waves dashed against the breakwaters, throwing the spray as high as the neighboring houses, while in the harbor and river the wind striking the caps of the waves filled the atmosphere with a fine mist like spray, so that at times it was impossible to see Norfolk, Berkeley or the ships in the harbor...."

1879 October 19-22: At Cobb's Island, a steady rain began on the 19th. Offshore, high winds and seas had already led to the destruction of the *Ellie Bodine*, a schooner, 4 ½ miles south of Smith Island. North winds shifted to the southeast late on the 21st at Cobb's Island. By 9 p.m., hurricane force winds overspread the islands and "shrieked in its mad glee". Tides rose past the high water mark around midnight. Bath houses were swept away. The coast guard's house began drifting inland with the storm surge.

At 4 a.m., the New York House was destroyed. By 5 a.m., water briefly invaded the Cobb Island Hotel, then the waters began to recede. Several cottages were no longer on the island. Sand dunes rose where none stood before. It took several years before the island recovered from the hurricane (Barnes & Truitt).

1881 September 9: For the first time in 33 days, rain fell at Washington D.C.. Wires from Wilmington, North Carolina south were downed by this "tropical hurricane".

1882 September 10-11: A tropical cyclone moved across Cuba and the Gulf of Mexico before striking the Florida panhandle. It crossed Georgia, the Carolinas, and went offshore near the lower end of Chesapeake Bay. On the Washington and Western railroad, a portion of the trestle work was washed out by heavy rains. At Amherst, a landslide delayed rail traffic for 5 ½ hours. Several bridges on the Alexandria and Fredericksburg railroad were "injured" by the deluge. The gale caused mischief to shipping off the Northeast and Nova Scotia.

1882 September 21-23: This tropical storm formed near the northern Bahamas and moved north into North Carolina near Cape Lookout. Along the Lower Rappahannock, the "protracted and destructive rain storm" swept away four mills near Ware's Wharf. The brunt of the cyclone only extended fifty miles inland. Heavy rains were also seen at Washington, D.C.. It then moved into Chesapeake Bay before moving out to sea on the 23rd. Eleven inches of rain were measured at Philadelphia. Extensive flooding was reported from North Carolina northward to Massachusetts.

1883 September 12: A "protracted drought" was ended across Virginia on the 11th, as the rains from this tropical cyclone reached the Old Dominion. Unfortunately, it came too late for the peanut crop, which had already failed. A train wreck which occurred on the Norfolk and Western railroad near Nottoway Court House Station may be attributed to this cyclone. Ten freight cars were derailed. The schooner *E.C. Knight Jr.* wrecked near Cape Henry.

1885 August 25: Floods accompanied this storm as it passed by the area. Copious rains fell in Baltimore, dropping the temperature 24 degrees in two hours. Flooding rains were seen across Maryland. In Maryland, lightning set fire to a residence in Ellicott City ($16,000 damage). On the steamer *Arrowsmith,* just offshore Cedar Point, high seas and a strong gale burst the bulkhead of the wheelhouse. For twenty minutes, the crew worked feverishly to fix the ship, which made it to Washington, D.C. only an hour late.

1885 October 12: A tropical system moved from southwest of Florida northward into the panhandle, reaching southwestern Virginia around midnight on the 12th. A large sea lion escaped its pen during the cyclone, and was last seen swimming down the Chesapeake.

1886 June 22: At Lynchburg, a "terrific rain" led to street flooding, setting a new record for the wettest June at the site (5.44"). In Washington, D.C., 4.16" of rain fell on the 22nd alone, setting a 24-hour rainfall record for June.

July 1-2, 1886: Two days of heavy rain led to flooding in southeast Virginia. The James at Richmond was ten feet above the high water mark, submerging all wharves, and leading to evacuations. Several trestles on the Richmond and Allegheny railroad were washed away, hampering travel. Washouts on the Richmond and Danville railroad led to a further stoppage in travel.

1886 August 24: This hurricane was first noted in the eastern Caribbean Sea in the middle of August. It tracked westward, before turning on a more northwest rack southeast of Jamaica. The beginning of a destructive week, it was followed by the strong Charleston Earthquake on the 31st (Vojtech).

1887 August 21: The British steamer *Propitious* encountered the storm sixty miles below Cape Henry. The captain of the vessel was swept overboard as heavy seas crashed over the decks. It was the worst weather system the ship had encountered in sixteen years.

1887 October 31-November 1: On the 29th, this storm moved northeast from Florida some distance off the Atlantic coast. Heavy gales were seen along the coasts of North Carolina and Virginia. The "furious northeasterly gale" caused telegraph lines to go down between Norfolk and Cape Henry. Winds were sustained at 78 mph for five minutes at Cape Henry.

A record number of maritime mishaps were caused by the storm. Four ships, the *Mary D. Cranmer, Carrie Holmes, Manantico,* and *Harriet Thomas* were lost. Two lives were claimed offshore (Pouliot). The *Carrie Holmes* was driven so high into the beach that its crew jumped off the schooner and waded safely to shore; it proved a $7000 loss.

1888 August 21-22: This hurricane initially devastated southeast Louisiana before recurving northeast through the Ohio Valley. At Wheeling, West Virginia, heavy rains led to a two to six foot submersion of area roads. Bridges were washed out. A piece of the Baltimore and Ohio wooden bridge from Pittsburg collided with one of their other bridges at Main and 16th streets, leading to its second destruction in six weeks. A quarter million in damages were reported.

In Petersburg, a "terrific wind storm" blew through town, uprooting trees. At Carter's Wharf, lightning struck during a baptism ceremony, killing three and stunning all that were present. The storm was severe around southern Chesapeake Bay, demolishing numerous wood-frame houses, barns, and two schooners. An immense waterspout swept out of Chesapeake Bay onto Poole's Island.

Heavy showers and high winds were experienced in Washington, D.C.. Winds were sustained between 40 and 50 mph, with gusts above sixty. These gales led to the destruction of the tower of the Church of the Covenant around 4:40 a.m. on the 22nd ($30,000 in damage). . At least two tornadoes were spawned in Delaware. Another tornado moved from Springfield across Glendale and Bowie, destroying homes, trees, and a chapel along the way. Nine perished in Maryland. Floods inundated Ohio, West Virginia, Pennsylvania, Maryland, Delaware, and Massachusetts.

1888 September 10: A tropical storm moved through the Bahamas on the morning of the 7th, before moving across the Sunshine State. The cyclone re then curved northeast around the Bermuda High, reaching Virginia by the afternoon of the 10th (track to the right). Four months of drought abruptly ended at Southside. Heavy rains completely submerged corn and tobacco crops. The Appomatox flooded wharves; the river reached its highest level since 1877. It was considered a "terrific gale" at Onacock. The British schooner Elk was driven ashore and stranded at Parramore Beach. All aboard were rescued.

1888 October 11: A hurricane moved northeastward from the Eastern Gulf of Mexico through North Carolina and crossed just west of Norfolk.

1888 November 25: A tropical system which moved about 150 miles off of Cape Hatteras produced high winds along the Mid Atlantic coast as it was becoming extratropical. Cape Henry saw sustained winds reach 72 mph for five minutes. Norfolk experienced winds howling at 50 mph for five minutes which knocked down telegraph lines and high tides flooded lower parts of the city; their pressure fell to 29.50".

Vessels were blown from their moorings. The sloop *Lizzie Jane* wrecked 1/4 mile north of Cobb Island. Cold air rapidly enveloped the storm, as the surfman at the False Cape Life-Saving Station reported blinding snow (Pouliot). Fortress Monroe, Winchester, and Richmond also went through a snow storm. Flurries in Washington, D.C. were accompanied by blustery north winds. Wires in the District were downed, and a telegraph pole broke off 25 feet from its base.

1889 April 6-7: Although this cyclone was not likely to have been a true hurricane, it showed all the telltale signs to those in Virginia Beach at the time. Winds were blowing at a "hurricane rate" from the north-northwest. Gusts exceeded 100 mph at the Signal Service station in Cape Henry. Trees were uprooted and sand dunes quickly transformed into quicksand during the heavy rain. The Cape Charles lighthouse saw its south end protection wall undermined as it was pounded by high waves. High tides totally surrounded the station (Vojtech).

Lower portions of Norfolk flooded as tides rose to 8.4 feet. A fire on Water Street raged out of control, consuming the entire block. Roofs of the Opera House, Masonic Temple, and many dwellings were blown away. The Virginia Beach railroad depot saw damage, as well as hundreds of yards of its track. A fire at Portsmouth destroyed a lime and lumber yard. The U.S. vessel *Pensacola* sank while in dry dock. High tides flooded its dock, and as the ship filled with salt water, its keel sank.

Richmond experienced its worst storm of the winter and spring. Heavy winds, rain, sleet, and snow pelted the state capital. Charlottesville's snow storm led to downed wires and delayed rail traffic. Petersburg experienced a horrible blizzard, as trees were uprooted, and houses "rocked" with the wind. Winchester measured fourteen inches of snowfall while at its height, with thunder startling their citizens. Telegraph wires were strewn across the countryside.

In Washington, D.C., rain turned to snow by 8:30 a.m. on the 7th. By 10:30, lightning and thunder were observed, leaving residents in awe. The Weather Bureau could not explain the occurrence of snow and thunder, but mentioned in would be known within a "few years". The blizzard caused thousands of dollars in damage, as telegraph and telephone lines were downed in great numbers. The White House had its communications cut off by the storm between 1 and 2 p.m., as the weight of the wet snow downed area lines. A tornado actually touched down amidst the chaos along the waterfront, as five telegraph poles were snapped at the base.

Three schooners stranded on Virginia Beach near the Seatack Life-Saving Station. The four- masted vessel *Benjamin F. Poole* was left high and dry on the beach after the severe cyclone. Blowing rain and sand almost blinded the surf men trying to rescue the *Emma F. Hart*. At 7 a.m. on the 7th, the Cobb Island Life-Saving Station keeper observed the sloop *J.O. Fitzgerald* race towards Bone Island, running aground 3/4 of a mile away. All offshore survived the tempest.

1889 September 9-12: This hurricane moved from Puerto Rico on the 5th to just offshore the Virginia capes on the 10th before stalling. The steamer *El Mar*, on its maiden voyage, encountered the hurricane on the night of the 9th just north of Cape Hatteras. The vessel fought seas higher than 45 feet and strong winds for the next couple days.

Destructive gales and unusually high tides were felt from Virginia northward to New York. Winds increased to 30 mph at Cape Henry on the 11th, temporarily knocking down telegraph lines to Norfolk. By the 12th, the lower coast experienced 40 mph winds. Along the Eastern Shore, bridges were swept away, telegraph lines were downed, lowlands inundated, and crops ruined. The wind "blew a hurricane" at Onacock, with high tides completely submerging its wharves.

Vessels at Hampton Roads dragged anchor. A brigantine-rigged steamer went ashore Cape Henry at 7 p.m.. The British steamship *Godrevy* grounded 3/4 of a mile northeast of the Cape Henry Life-Saving Station, just before 8 p.m. on the 12th, which proved a $11,900 loss. The crew of 23 were saved. Winds and seas moderated by midnight.

1889 September 24: President Harrison was visiting Elkins, West Virginia at the time, and noted that it rained considerably.

1891 October 10-12: A system born in the Western Caribbean moved northward to just off the North Carolina coast. The U.S.S. *Despatch* , the President's ship, foundered 2 ½ miles north of Assateague Beach on its way to pick up the Commander-in-Chief. The sailing ship *Challenge* fell victim ½ mile southwest of Wachapreague (Pouliot).

1893 June 15-16: A hurricane hit Cedar Key, Florida and moved northward across coastal sections of the Carolinas before moving out to sea near Norfolk. Birdnest, in Northampton County, recorded 4.8" of rain on the 16th.

1893 August 28 (Sea Islands Hurricane): A hurricane passed just east of Cape Hatteras. Five minute sustained winds rose to 88 mph at Cape Henry. Cape Henry (3.97"), Hampton (3.92"), Langley Field (3.92"), and Norfolk (5.97") set 24 hour rainfall records for the month of August in this storm. Petersburg experienced a "perfect gale" between 4 and 5 p.m.. Trees and fences were leveled. Area orchards were greatly damaged. Corn, fodder, and tobacco were seriously injured. At Harper's Ferry, a damaging wind and rainstorm began at 7 p.m.. The District Militia's camp was demolished. A large number of trees were uprooted.

Alexandria plunged into darkness at 9 p.m., as power was cut off by the cyclone. Trees fell in by the score. Considerable damage was does to trees and the corn crop in Alexandria and Loudon counties. Small craft at the wharves sank. The river overflowed wharves, at the water from the river extended into Union Street. At the waterfront, the steamer *W.W. Colt* was badly damaged. The hull of the schooner *Franconia* was in serious disrepair. Fifty tons of coal were claimed by floods at Anacostia. A washout occurred at Cherry Hill Station, along the Washington and Southern railroad, rerouting train traffic.

In Washington, D.C., telegraph and telephone lines were "laid prostrate" on the night of the 28th as five-minute sustained winds reached 42 mph. For the first time in weeks, a good rain fell across the area. By 10 p.m., a smokestack was blown off a locomotive. The Pension Bureau roof was torn away by the high winds. Windows were shattered throughout the Federal City. Tides at Washington, D.C. peaked at 6.5 feet above low water datum. One man near Raleigh Springs, in northern Virginia, perished while trying to ford a stream.

1893 October 4 (Chenier Caminanda Hurricane): In Louisiana, 2000 lives were lost when the hurricane crashed into the region around Grand Isle (track to the left). As the system was exiting the Mid-Atlantic coast, the schooner *Colter C. Davidson* sank south of Cape Henry. Two three-masted schooners were stranded on the beach near the Seatack Life-Saving Station. The northeast gale battered the schooners *W.M. Applegarth* and *C.C. Davidson* that evening.

In Washington, D.C., a "perfect deluge" led to the flooding of the Patent Office. All the examiners, clerks, messengers, and laborers began to rescue valuable records and property from the rising waters. Many cellars along the south side of Pennsylvania Avenue from Third to Thirteenth Street were flooded. The depot of the Baltimore and Potomac railroad looked like a "light-house, standing as it did in the centre of an immense lake" near the intersection of B and Sixth Street.

1893 October 13-14: While the previous system was moving across North Carolina, another hurricane lurked east of the Leeward Islands. This hurricane of large size tracked east of Florida to the Carolinas. High winds and tides were seen from Florida northward to New England (Barnes II).

At Richmond, winds became a "perfect gale" as rain fell in torrents. Homes were partially unroofed, and trees fell in the capital squares. Between Richmond and Danville, a passenger train struck a fallen tree while a freight train struck another tree. Many lines fell across Petersburg. Dwellings in town rocked to the wind gusts. Barns and outhouses were razed to the ground. Roanoke watched as their river rose to levels unseen since 1853. Washouts occurred along the Norfolk & Western railroad, delaying traffic from twelve to fourteen hours. The town of Elliston was submerged by the Roanoke river, sweeping away houses. During this storm, 2.98" of rain fell at Stone Gap, setting a 24 hour rainfall record for the month of October.

Alexandria saw its wharves crumble before the high waters ($25,000). The James river eclipsed the level attained during the Johnstown Flood of 1889 by twelve inches. A fire in Baltimore burned down its electric light plant, giving the city more of the look of a "country town." Hyattsville saw a terrific gale by 5 p.m., putting its windmills briefly out of commission. Bladensburg saw winds level fences and partially unroof homes.

In Washington, D.C., the Calvary Baptist church's side wall blew down ($3000). Associate justice of the Supreme Court Henry B. Brown was seriously injured when a plate glass window shattered at his new home at the northwest corner of 16th street and Riggs at 7:30 p.m.. Trees and their limbs were strewn throughout the city. Rainfall began in the morning and increased throughout the afternoon. Sewers were flooded by this downpour. By 6 p.m., gale force winds swept through the Federal City. Damage to police and fire wires was "greater than ever before been experienced." Waters on the Potomac rose six feet above the high tide, which was three feet below the high water mark. The Anacostia bridge became submerged.

Mariners experienced the wrath of this hurricane as well. The schooner *Edward Ewing* sank at Store Point, south of the Piankatank river. In the District of Columbia, the steam launch *Katherine Holbrook* sank. The *Nellie Marr* saw its bottom smashed by the high seas. The freight vessel *Mount Vernon* sank at her wharf. The *W.W. Colt* went on a rampage, injuring two other vessels before crashing against the ferry slip, smashing her port side.

1894 September 29: This hurricane passed just west of Hatteras. Winds sustained for five minutes at Cape Henry peaked at 80 mph with gusts to 90 mph. Vessels were wrecked along the coast from North Carolina northward to New England.

1894 October 9: A hurricane which formed just offshore Panama and Colombia moved north to hit Apalachicola, Florida and moved across coastal sections of the Carolinas before heading out to sea near Norfolk, restriking the coast at New England. The storm was severe in the Chesapeake Bay. The steamer *Eastern Shore* was nearly buried by high seas. The *Henry Lippet* was severely damaged after a collision 3/4 of a mile below Fort Monroe. A steam barge ran aground near Baltimore Harbor.

At Newport News, a terrific rain and wind storm raged. Northeast winds reached up to 60 mph. Many maritime disasters were witnessed. Among the wrecks were the schooners *Lorena Reen, John H. Cross,* and the bark *Ogin.*

1896 July 8-9: This hurricane struck the Florida panhandle just east of Pensacola on the morning of the 7th. The decaying tropical storm moved north into the Ohio Valley. On the favorable eastern side of the system, tornadoes touched down across North Carolina and Virginia, leading to isolated pockets of destruction. A tornado swept through Dinwiddie and Prince Georges counties. Dwellings were leveled, along with trees and outhouses. Buildings were lifted up and moved fifty yards. Six perished.

Torrents of rain along the Atlantic & Danville railroad led to the Dan river overflowing its banks, flooding thousands of acres of low lands. Several bridges were swept away. Damage to crops, particularly corn, occurred with the flooding. Many cattle were drowned in swamps around Norfolk.

1896 September 28-October 2: A hurricane developed in the breeding grounds of the tropical Atlantic before moving through the Caribbean Sea and the Gulf of Mexico. The system then tracked inland through the Southeast to the west of Washington D.C..

Richmond suffered severely from the cyclone. Communication was gone early on during the storm... the only line that remained open belonged to Western Union, the wire than ran to Wilmington, N.C.. A "perfect wilderness" of uprooted trees and downed limbs lay everywhere. The steeple of the Second Baptist church yielded to the storm, falling across main street. The Governor's Mansion survived the cyclone reasonably well. Damage totaled $150,000 at the state capital.

Petersburg witnessed a "perfect hurricane" between 7:30 and 10:30 p.m.. The Imperial Hotel was unroofed. Smaller buildings experienced great damage. The Western Union office took fire, but the blaze was quickly extinguished. All lines were downed. "Needed rains" fell at Leesburg, but high winds at that locale led to high timber losses. Fredericksburg saw its St. George's church steeple injured by the cyclone.

In Alexandria, damage was widespread. The Third Baptist Colored church was razed to the ground ($5000). Over forty windmills were wrecked at Falls Church. Travel was virtually impossible due to the volume of downed trees which blocked the roadways. Hyattsville and Bladensburg experienced injury, as windmills fell, and numerous windows and skylights were shattered. Wood-frame buildings were blown from their foundations. Manassas saw its Evangelical Lutheran church blown six inches off its foundation.

At the nation's capital, a rapidly moving deck of low clouds streamed in from the Atlantic on the heels of brisk southeast winds. After the wind shifted to southwest, thunderstorms caused continuous lightning to light up the night sky. It was one of the worst storms on record in the District of Columbia as five-minute sustained winds peaked at 66 mph and gusts reached 80 mph; the pressures fell to 29.14" around 11 p.m.. At 10:30 p.m., the steeple to the New York Avenue Presbyterian Church crashed to the ground. A five story brick building was demolished, injuring the adjoining buildings, trapping five men under debris. The tower of the Grand Opera House was "hurled to the sidewalk."

Uprooted trees blockaded several streets in the District. A horse perished after stepping on a live wire. Many buildings were unroofed. The Metropolitan Railroad Power House in South Washington caved in, causing all buildings within one-half block to shake; its crash was audible a mile away. Capitol Hill saw even greater damage. Georgetown experienced its worst storm ever. The Baseball Park saw $500 in damage. A few panes of glass at the White House were shattered as well. Winds began to subside by 12:55 a.m.. In all, a $390,000 in damage was incurred.

Heavy rains fell as well...see the chart to the left for 24-hour rainfall records set for September during this cyclone. A flash flood at Staunton, along Lewis Creek, overran its banks, killing five. Seven inches of rain on the 30th swelled a large lake near the town, bursting its dam at 10 p.m.. Alarms were sounded as torrents of water rushed down Central Avenue, submerging everything in its path. As it invaded the Water Works and electric plant, fires in their furnaces were quickly extinguished, plunging the city into darkness. The gas works was swept away by the raging flood. Twenty-five houses were moved from their foundations before crumbling in the angry waters ($500,000). Great washouts occurred along the Norfolk & Western railroad from Roanoke to Hagerstown. Streets in Roanoke became rivers. On the 1st, the Potomac and Chesapeake & Ohio Canal merged into one as flood waters increased their height and breadth. At Buena Vista, the fire department wall called in to save those in peril from their floods.

Tides rose to 7.0 feet above low water datum at Washington, D.C.. The scene at the waterfront was "one of indescribable confusion." Power was out, and mud had invaded surrounding land areas. Most everything, including vessels in and around the wharf was destroyed. The steamer *George Leary* ran amok when her wharf succumbed to the storm. Careening with the current, she crashed against the *Sylvester*, when then took part in the joyride. They crashed into four other vessels before coming to rest against the Norfolk steamer *Washington.* From Cedar Point to Sandy Point, fourteen vessels went ashore. The schooner *Capital* foundered at anchor, taking the lives of here crew (three in all).

Cobb's Island was submerged. Its hotel was demolished, along with any remaining cottages and private dwellings that weren't destroyed during the powerful nor'easter of 1895. This storm led to the abandoning of the island by Fall of 1897 (Barnes & Truitt). Damaging winds spread northward through northern Virginia, Maryland, and Pennsylvania. Its gale force winds extended from New York to Chicago. Sixteen perished across the region: three in D.C., seven in Virginia, and six in Maryland. Total losses exceeded $1.5 million in Virginia and the District of Columbia.

1896 October 11-13: Serious damage occurred at Virginia Beach, amounting to several thousand dollars from this cyclone. Winds of 40 mph blew through Norfolk while 70 mph lashed the Capes. The Cape Henry lighthouse keeper's residence was submerged by the system's storm surge. High tides reached the life-saving station. Water was blown up to the boardwalk of the Princess Anne hotel. All telegraph wires and poles were carried away by the tide. Around Norfolk, the Dismal Swamp canal was badly flooded; its banks "honey-combed and caving in many places." Two perished.

A northeast wind arose at Cobb's Island on the morning of the 5th and increased as the day wore on. It became a gale, then a hurricane, which moved the islanders into action. All furniture was moved into the upper floors of structures to escape the rising waters. Soon the island was completely submerged. As people watched from their second stories, stock and cattle were swimming around their homes, expressing their distress. Among the animals in the surging waters were horses, cows, goats, and dogs. The highest points went underwater before the lifeguard went from house to house, saving people's lives.

The Baltimore cottage was a total wreck, battered by the waves. Several cottages were found half buried in the sand. The island shrunk to a size of only fifty acres after this storm (Barnes & Truitt). At False Cape, eight fishermen took refuge at the life-saving station. Two women on Cobb Island were rescued by surfmen, as heavy swells were sweeping them out to sea. It was two days before the weather improved, and the coastal flooding receded (Pouliot). The bark *Henry A. Litchfield*, with a cargo of lumber, went ashore Pleasure House Beach between 4 and 5 a.m. on the 12th, twenty four days out of Brunswick, Georgia. It braved the previous storm at the end of September, before succumbing to this cyclone.

1897 October 20: A rapidly moving storm of tropical origin passed northeastward off Cape Hatteras. Maximum winds of 60 mph blew through Cape Henry.

1897 October 24-26: On the 24th, this misbehaved tropical cyclone went from a northeast course to a more dangerous northwest course towards the Mid Atlantic region. It completed a small loop off the Virginia capes before heading westward into extreme northern North Carolina. A number of small craft had already washed ashore on the 24th. At Cape Henry, winds reached 64 mph on the 24th. Low streets of Norfolk were flooded. Two fatalities occurred when one person came in contact with a live wire and another was on the telephone. On the 25th, the James river rose to five feet above high tide. The catboat *Louise* was blown ashore Newport News, proving a total loss. Winds at Cape Henry rose to 70 mph. Increasing tides cut a break through Willoughby Spit, washing away the Old Point Comfort railroad tracks.

Trees were leveled at Hampton. Cobb's Island went totally underwater, forcing the crew of the life-saving station to abandon the isle. The 26th brought continued northeast gales to the coast. A Norwegian sailing ship was being destroyed while in tow fifty miles southeast of Cape Henry, and was abandoned. All aboard survived. Four fatalities were reported at Newport News. In all, this storm lasted for 60 hours and produced tides of 8.1 feet above mean lower low water. Winds and high water inundated the business section of Chincoteague. The hotel on Metompkin Beach was wrecked. Cedar Island was "leveled to a mere flat breath of sand" (Barnes & Truitt). The schooner *L.A. Rose* went down one mile southeast of Assateague Beach while the steamer *Polaria* wrecked one mile northwest of Cape Henry.

1899 August 17-18 (San Ciriaco Hurricane): The damage produced by this storm in North Carolina is considered unparalleled. It left its mark in Virginia as well. On the 16th, wind at Cape Henry reached 52 mph. By the 17th, Cape Henry saw winds peak at 68 mph for five minutes, and gales expanded westward past Norfolk...low lying areas were inundated. Norfolk's pressure fell to 29.62" as five-minute sustained winds reached 42 mph.

The storm was quite severe along the James,. At Suffolk, livestock drowned in the flood waters. At Petersburg, a "heavy northeastern storm" began the night of the 17th. Corn and tobacco experienced considerable damage as crops were leveled by the wind.

1899 October 30-31: This storm took a similar path to Hazel. It was becoming a nontropical low while passing through North Carolina, but that didn't weaken the system at all. Cape Henry saw winds of 74 mph over a five minute period. Norfolk tides reached 8.9 feet above mean lower low water. Norfolk experienced 50 mph winds level trees and signs...windows in the area shattered. Brighton experienced the leveling of several homes. Tides again created a break in Willoughby Spit, damaging railroad tracks. In Danville, the gale reached its height between 7 and 8 p.m. on the 30th, unroofing several houses and damaging shade and fruit trees. Winds died down by noon on the 31st.

The Cape Charles lightship was under significant strain; the starboard chain broke and carried away all the castings and connections. The three-masted schooner *Kate Darlington* wrecked on Ocean View Beach at 1 p.m. on the 30th, after being struck by a steamer on the Virginia Capes. The schooner *W.S. Rowley* beached at Nix's Wharf in Suffolk...two wharfs there were badly damaged. The 1000-ton, four-masted schooner *Bayard Barnes,* after springing a leak, became stranded on Willoughby Spit. Damage from the cyclone spread northward into Ontario and Newfoundland, in Canada.

TWENTIETH CENTURY

1900 October 13-14: The six-masted schooner *Wells,* proclaimed as "the only of her kind in the world" sought shelter from the gale in Norfolk, with a 5000 ton cargo of coal.

1901 July 10-11: On the 10th, northerly gales commenced from Cape Hatteras to Henry. Winds averaged 50 mph at Cape Henry that night, which downed lines. A severe thunderstorm in Richmond, on the western fringe of this storm, claimed a victim when lightning struck a tree in her yard. In Berryville, heavy rains and winds did great damage to crops as it leveled trees and stripped off fruit during the cyclone. A barn was struck by lightning, instantly setting it ablaze ($2000). Artillery practice in the Chesapeake Bay was interrupted as high winds wrecked floating targets.

1901 September 16-18: A "terrific northeaster" prevailed along the coast. Four men off Ocean View drowned after setting sail during the storm. Newport News reported 3.32" of rain, which set a 24-hour rainfall record for the month of September. The schooner *Joseph J. Pharo* went down 1 ½ miles south southeast of Assateague Beach on the 16th. By the 17th, the schooner *Edith G. Folwell* wrecked one mile north of Cape Henry. The sloop *Dude* capsized off Sewells Point. Those aboard clung to the wreck and were rescued and taken to Cape Charles. The schooner *Idle Times,* while in Chesapeake Bay, was "run down" by a Pennsylvania railroad barge that was in tow, killing the schooner's captain.

In Maryland, Braddock experienced significant damage leaving few homes, barns, or outbuildings untouched. Poplar Terrace was damaged as a water tank was swept off the house. Nearly 300 window panes were destroyed by the wind there. Two horses perished. Montevue hospital's roof was partially torn off as 1500 windows were demolished. At Liberty, twelve barns overturned. Growing corn was in ruin.

1902 June 14-16: On the 14th, the steamer *Falcon* fell victim to the storm two miles southeast of False Cape. Twenty-four hour rainfall records were set for the month of June during this cyclone at New Canton (3.70") and Fredericksburg (3.45") on the 16th. The deluge broke a drought, benefiting tobacco crops most.

1903 September 15-17: This deadly hurricane struck the New Jersey shore. It was considered the worst storm in forty years at Ocean City, MD. Salisbury saw several schooners break from their moorings, smashing themselves downstream. President Theodore Roosevelt experienced the hurricane firsthand while aboard the naval yacht *Sylph*, as winds increased to 65 mph in Long Island sound. Other than a drenching, all aboard fared well. At the Delaware Capes, 80-mph winds lashed the schooner *Hattie A. Marsh*, dashing the vessel upon the rocky shore; five perished. The torpedo boat destroyer *Lawrence* took on a foot of water while fighting the storm from Atlantic City to Norfolk.

In Virginia, a strange scene unfolded. As the cyclone passed northeast of Old Point Comfort, a shower of dead birds, most feathers plucked off by the wind, fell from the sky. Hundreds of birds, about the size of a wren, were downed around Old Point Comfort. The foremast of a schooner was claimed by a squall near Cape Henry around 3:30 a.m. the 17th. A few small craft were thrown ashore. The fishing schooner *Beatrice* disappeared into the cyclone several miles north of Chincoteague with a crew of 30 ($25,000). In the District of Columbia, heavy rains washed out a baseball game between the Washington Senators and the Detroit Tigers. Strong west winds accompanied the deluge as it flooded the field.

1903 October 8-10: Cape Henry saw winds over five minutes average 74 mph with a tropical system that became nontropical off the Outer Banks of North Carolina. Norfolk's tide rose to 9 feet above mean lower low water. In Norfolk, a tree brought from the grave of Napoleon Bonaparte to the city was uprooted; it was one of most historic features of the city at the time. Plate glass windows shattered in the wind. Communication was wiped out as wind knocked down wired and cables. It was the worst storm in 15 years, as rain and wind plagued the city for over 48 hours.

At Richmond, a "furious wind storm" descended upon the city the morning of the 9th, accompanied by a 20 degree fall in temperature. Trees were uprooted and communications were "disturbed" in the state capital. An elderly man in Leesburg drowned while trying to cross over Little River on a log.

The coast of the Old Dominion was strewn with wreckage from Cape Henry to Dam Neck Mills on the 10th. Fourteen foot high waves battered the Back River lighthouse; stones from the light were moved out of place. It took 72 hours of continuous work to save the light, its house, and the walkway (Vojtech). The cruiser *Olympia*, in dry dock at Norfolk, saw the tide reach just six inches from the top of the outer edge of its caisson. Terminal piers of the Norfolk & Western and the Southern & Atlantic Coast lines were badly damaged. The Ocean View pleasure pier was wrecked.

At the nation's capital, the grain mill and elevator of S.S. Dalsh & Co., located on Florida Avenue, burst into flame during the storm at 11 a.m. on the 10th, leading to a $90,000 loss. Another fire at a stable along Jackson Street Northeast was entirely destroyed, its two horses perished ($400). A fierce gale blew throughout the 9th during the Columbia Golf tournament. It took more than two hours to go through the rounds.

Two men drowning off Virginia Beach were rescued by a member of the Cape Henry Life-Saving Station, earning him a Gold Life-Saving Medal (Pouliot). The Assateague Beach life savers rescued eight fishermen when their home was swept away by high waters. The Wachapreague Life Station was abandoned when it was becoming submerged by the storm surge. High water threatened other dwellings at False Cape.

In the Lower Chesapeake, two three-masted schooners were blown ashore on the 9th. The tug *Richmond* was battling a northeast gale by late on the evening of the 8th. The schooner barge *Georgia* parted cables and drifted ashore near the Virginia Beach Life-Saving Station. Hurricane-force winds took their toll on the schooner barge *Ocean Belle*, before its cables broke at 10:30 a.m. on the 10^{th}. The schooner landed broadside on the beach before immediately breaking up in the dangerous waves. Two perished. The *Nellie W. Howlett* sank three miles south of the Dam Neck Mills Station. In all, nine ships had mishaps offshore the Old Dominion. Three perished. As the cyclone moved north, rains amounting to ten inches drowned New York City. Damage was experienced up the coast to Block Island.

1904 September 14-15: This storm made landfall in eastern South Carolina before moving north and northeast to pass offshore as a nontropical low near Norfolk. Ashland recorded 3.88" of rain on the 14^{th}.

1904 November 13: This hurricane moved north to near Cape Hatteras. As the system became nontropical, cold air on the west side of the circulation set up an early snowstorm across North Carolina. A twenty-four hour rainfall record was set for November at Farmville (3.17"). The schooner *Robert J. Poulson* went down one-half mile southwest of Hog Island on the 13^{th}.

1913 September 3: Danville set a new 24-hour rainfall record for September (3.59").

1920 September 30-October 1: The schooner *Thomas F. Pollard* foundered off Cape Henry.

1924 August 26: This hurricane passed just east of Cape Hatteras. Maximum sustained winds reached 72 mph at Cape Henry.

1924 September 29-30: Norfolk saw winds reach 76 mph sustained from a cyclone that became nontropical over the Southeast U.S.. In Fauquier county, four inches of rain fell at Leads Manor on the 29^{th}. In Richmond county, 4.6" of rain fell at Warsaw on the 30^{th}. Leeds Manor (4.00"), Stuart (4.20"), Urbanna (3.80"), and Winchester (2.05") all set 24-hour rainfall records for September during this tempest. The moderate flood along the C & O canal created by the cyclone led to an end of boating operations (High).

1925 December 2: A rare hurricane formed in the Caribbean Sea and moved north northeast across South Florida and moved into the East coast between Wilmington and Cape Hatteras at 6 p.m.. The storm center passed out to sea near Cape Henry. Langley Field reported 3.36" of rain on the 2^{nd}. Other 24-hour rainfall records for December were set during this storm at Callaville (2.24"), Onley (2.30"), Runnymede (2.51"), and Warsaw (3.10").

1928 August 11-12: A category two hurricane moved northwest across Florida on the 7^{th} and 8^{th}, weakening as it wandered northwest into Georgia. The decaying system dumped more than six inches of rain across the Carolinas and Virginia as it moved northeast, sending river levels well beyond flood stage (Barnes II). Norfolk recorded 39 mph sustained winds on the 12^{th}. Heavy rains fell at the Sewer Department in Washington, D.C. when 7.31" deluged the area. The brig *Walton* foundered off Sandy Point, Maryland during the storm.

1928 September 19 (San Felipe/Lake Okeechobee Hurricane): This tropical cyclone was experienced by the *S.S. Commack* near 17N 48W, and send a radio report about their weather conditions. This was the most easterly radio report concerning a tropical storm in the Atlantic at the time (Barnes II).

Epic destruction and loss of life from this vicious storm spread across Puerto Rico and Florida before it tracked into North Carolina. This storm caused tremendous flooding in North Carolina. Maximum sustained winds were 72 mph at Cape Henry. Tides peaked at 7.2 feet above mean lower low water at Norfolk. Heavy rains were seen at Langley Field on the 18^{th} (3.88") and Onley on the 19^{th} (5.22").

1933 August 21-24 (Chesapeake-Potomac Hurricane): On the 17^{th}, a tropical storm was discovered about 100 miles east of Puerto Rico. This system quickly strengthened into a hurricane by the 18^{th}, as it tracked northwest (track to the right). As the cyclone neared Bermuda, a blocking high pressure ridge over New England changed the storm's course to more westerly. The British colony of Bermuda was lashed by 80 mph winds as the center passed 100 miles to the southwest of the island. \

Rough surf conditions developed near Hampton Roads during the afternoon of the 22nd. The system made landfall near Nags Head around 3 a.m. on the 23rd. By 9 am, the center passed over Norfolk, where the pressure fell to 28.68". Some of the lowest pressures ever measured in Virginia occurred with this hurricane. The lowest pressure of 28.68" occurred at 9:20 a.m..

This was the first time an eye of a hurricane had passed over Norfolk since the great hurricane of September 3, 1821. Sustained gales extended well inland over northern sections of Virginia. Maximum winds were 58 mph at Washington D.C., 70 mph at Norfolk, 82 mph at Cape Henry, and 88 mph at Norfolk Naval Air Station. Areas near the Chesapeake saw over 10 inches of rain (rainfall map below). Some areas measured eight inches of rain in one day. Washington D.C. experienced a 6.39" deluge.

This storm produced a record tide of 9.8 feet above mean lower low water at Sewells Point. Norfolk saw a tide of 9 feet above mean lower low water. Five feet of water flooded the city, damaging area crops.

A six to nine foot storm surge passed up the Chesapeake Bay. A combination of the storm's surge and back water flooding along the Potomac caused crests as high as 12 feet above mean lower low water on the river. Colonial Beach stood by helpless as four feet of water flooded the town and swept the town's amusement park away. Water also flowed into some hotels bordering the Potomac River.

Severe flooding occurred at Alexandria and Washington D.C.. In Washington, D.C., numerous trees were uprooted and many houses unroofed. The Potomac at Alexandria reached its highest stage since the Johnstown Flood of 1889. In Alexandria, high winds played havoc with phone and power lines. High water in Four Mile Run cut off Alexandria from the Federal City. Two men were nearly doomed when the Cameron Run bridge on Telegraph Road was washed out. Farms in Fairfax county suffered heavy damage; fields were flooded, ruining crops. All aviation activities out of Quantico were suspended. High winds and rains flattened corn crops and damaged peach orchards in Loudon county. St. Mary's county saw damage to corn and tobacco. In the Richmond area, damage was confined mainly to broken windows and downed tree limbs. In Anne Arundel county, 44 mph winds took a heavy toll on crops, leading to $250,000 in damages alone.

Some high water marks in Alexandria included 2 feet at the Ford Motor Company Plant and 5 feet at the Old Dominion Boat Club. Flood waters completely inundated the lower end of King Street in the Old Town section of Alexandria. The Washington-Richmond highway (U.S. Route 1) was inundated to a depth of 8 feet in a few sections below Alexandria at the height of the storm. Mount Vernon Boulevard was under 5 feet of water. Flooding in the Anacostia river rose over the seawall.

The Washington Hoover airport was inundated to a depth of three feet at the height of the storm. The Benning Bridge was under two and a half feet of water blocking vehicular traffic. Of considerable note was the landing of a pilot named J.B. Duckworth at Washington, D.C., then an Eastern Air Transport night mail flyer who flew by instruments a large way from New York, just before the storm closed down the airport. He would later become the first pilot to intentionally fly into a hurricane off the Texas coast in 1943.

Tidal flooding from the hurricane extended up the tributaries draining into the Chesapeake Bay as well. The James River at Surry, some 40 miles from Hampton Roads reached the highest level in recorded history at 10 a.m. on the morning of August 23, 1933 as the tidal surge swept away the Surry Pier serving the Surry-Jamestown Ferry. The tidal surge moved further up the James River flooding Hopewell and portions of the city of Richmond. River levels were generally three to five feet above normal from Hopewell westward into Richmond.

On the other side of the James River, waters were estimated to be five to eight feet higher than any previous high water mark in the city of Newport News. The York river also went on a rampage and surged into Gloucester Point at the extreme southern end of Gloucester County . The town Post Office and Drug Store were completely demolished. Four feet of water stood in the lobby of the Robbins Hotel.

Wave action from the hurricane turned the Assateague peninsula into an island. Ocean City inlet was carved out by this cyclone. Most of what was left of the tourist industry on the Virginia barrier islands disappeared. The hotel on

Cedar Island was destroyed. The clubhouses on Wallop's, Parramore, Revel's, Hog, Cobb's, Mockhorn, Skidmore, and Smith's Islands were badly damaged....and they never recovered. An inlet was formed at Ocean City that remains to this day (Assateague Naturalist). At least ten vessels met their fate in the hurricane.

The fifty-foot schooner yacht *Bluejacket* put out to sea from Sandy Hook, NJ on the 20th. As the boat sailed offshore, high northeast gales developed, and the ship headed for Atlantic City. At daybreak on the 21st, while just off Chincoteague, gales increased just before a lull...the hurricane's eye. Sixty to seventy foot waves knocked the *Bluejacket* around as the winds reached "terrific force" from the southwest... estimated at 100 mph. Pyramidal seas knocked down the masts and the rudder was carried away. Eventually, conditions improved and by the 24th, the *S.S. M&J Tracy* rescued the aimlessly drifting vessel, and the crew arrived at Newport News that night. Fewer than 18 perished in Virginia. Tens of millions of dollars of damage was incurred by the hurricane.

1933 September 16: On the 8th, a tropical storm was sighted 180 miles east of the Leeward Islands. It moved north, then northwest, as the Bermuda-Azores High re-established itself across the western Atlantic. Following a parabolic course, the hurricane made landfall near Cape Lookout on the morning on the 16th as a formidable category three hurricane on the Saffir-Simpson scale. The hurricane quickly recurved northeast, passing 80 miles east of Norfolk around noon (track to the left).

Heavy damage was seen with this storm in Virginia. Winds rose to 75 mph at Hampton Roads, 87 mph at Cape Henry, and 88 mph at Norfolk Naval Air Station. Tides reached 8.3 feet above mean lower low water at Sewells Point. This hurricane reshaped the peninsula where New Point Comfort lighthouse stood into an island.

1935 September 4-6 (Labor Day Hurricane): The most powerful hurricane ever known to strike the United States, this storm of small diameter moved across the Florida Keys, killing 400 people on its way into the Gulf of Mexico. Its pressure of 26.35", as it passed over the north end of Long Key, became a record low for a land based station in the Western Hemisphere. The system recurved into Tampa Bay and crossed through Georgia and the Carolinas before emerging back into the Atlantic near the North Carolina/Virginia border.

Southeast Virginia saw winds gusting between 40 and 50 mph. Several tornadoes touched down in eastern sections of the state. The most significant tornado tore its way from Portsmouth across Craney Island, western sections of Norfolk, and Willoughby Spit. The oil screw vessel *Co* burned off Chesterton, Maryland. The steamship *Fannie Mae* foundered in the storm one mile east of Windmill Point lighthouse. Three died due to the storm. One million in damages was exacted from Virginia.

1936 September 18:A tropical storm formed deep within the tropical central Atlantic. It moved west northwest, becoming a hurricane by the 11th. Storm motion slowed, as a nontropical low passed well to the north, causing the system to turn more towards the north. By late on the 12th, high pressure re-established itself to the northeast, and the hurricane resumed its northwest track. Recurving as it made landfall in the Outer Banks of North Carolina, the system accelerated northeast, passing just offshore Norfolk, Cape Cod, and Nova Scotia (track to the right).

This storm was one of the most severe in the history of Cape Hatteras. Norfolk experienced severe flooding. The highway from Currituck to Norfolk was washed out by heavy rains. Buena Vista along the James River set a record crest (22 feet), as did Westham (23.4 feet). Maximum sustained winds reached 68 mph at Hampton Roads and 84 mph at Cape Henry, before the anemometer failed. Tides rose to 9.3 feet above mean lower low water at Sewells Point. The schooner *Clemmie Tavers* was left stranded at Norfolk. Only one person lost their life to the storm.

1938 September 17-21 (Long Island Express): One of the fastest hurricanes ever known to move across the western Atlantic (Emily in 1987 the most recent tropical cyclone to challenge its title), this major hurricane went on to devastate New England. As the low began to take on some nontropical characteristics, its wind field expanded as it passed about 175 miles off the Virginia coast. Gusty winds of 50 to 60 mph blew by the Virginia Capes, even though the state was on the weak west wide of the hurricane. Roanoke's pressure fell to 28.62". Cape Henry was lashed by sustained winds of 57 mph.

A stationary front was located along the East Coast prior to the storm's arrival. When the hurricane approached, rain fell in torrents from Virginia northward. Some areas along the Eastern Shore recorded over eight inches of rain with the passage of this great hurricane. Losses were minor compared to the catastrophic losses incurred in New England.

1940 August 13-18: First observed between St. Martin and St. Thomas on the 5th, this tropical storm began to curve northwest, to the northeast of the Bahamas. Winds reached hurricane force at that time. A high pressure system built in to the north of the cyclone, forcing is on a more westward course to the near the Georgia/South Carolina border. The system meandered across the Southeast U.S. for four days, before becoming diffuse on the 15th.

Rains began in Virginia on the 13th, as the dying storm entered the state from the west. Deluges flooded locations statewide. Hampton Roads measured 4.76 inches. Emporia, on the Meherrin river, reached a flood of record on the 17th, when the stage crested at 31.50 feet, which was 8 ½ feet above flood stage. Mountain rivers and streams went on the rampage, washing out bridges and causing landslides which blocked roads. Several principal highways between Norfolk and southwest Virginia and Asheville were closed. A collision on the 13th involving the Oil Screw *F.B. Scarbrough* five miles above Coles Point may have been caused by this system. Sixteen died in the mountains of Virginia, Tennessee, and North Carolina due to the storm.

1944 September 14-15: A storm which moved northward along the eastern seaboard from North Carolina up to Newfoundland caused widespread damage (track to the left). Hampton Roads saw winds of 72 mph gusting to 90 mph. Winds of 134 mph sustained with gusts to 150 mph lashed Cape Henry...a wind record which remains standing today for the state. Virginia Beach saw the pressure fall to 28.80". The gas screw *May Dee* foundered off Ocean View. See the table below for other pressures reported across the region.

Rainfall from the storm caused a flood of record at State Farm on the James river (26.4 feet). Damage totaled $2.5 million. Forty-six perished. Also of note, this system was the first time that air force reconnaissance air craft were used to monitor a storm threatening the East Coast.

1949 August 28 (Delray Beach Hurricane): After devastating Florida with winds gusting to 160 mph, this cyclone tracked through Georgia and the Carolinas, where heavy rain caused river flooding (track of this storm above). One tornado touched down in Tidewater. Heavy rains spread northeast through New England, ending a long drought (Barnes II).

1953 August 13 (Barbara): Early on the 11th, a tropical storm was discovered in the southeastern Bahamas. It became a hurricane northeast of the Bahamas on the 11th and gained intensity as it moved north. At 10 p.m. on the 13th, it struck the North Carolina coast between Morehead City and Ocracoke (track to the right). The storm then moved north and northeast, before going out to sea just south of Norfolk.
Winds reached 63 mph with gusts to 76 mph at Norfolk. Winds at Cape Henry were sustained at 72 mph. Cape Henry lighthouse saw its copper canopy torn loose during the cyclone. Rainfall amounts of five to eight inches were common across southeast Virginia. Portsmouth saw 9.3" of rain deluge the city in only 24 hours.

1954 August 25-31 (Carol): Hurricane Carol, a major hurricane when it made landfall in North Carolina, moved northward into New England (track above and below). It moved 100 miles off the Virginia Capes and brought winds of 40 mph to Virginia Beach. Norfolk received four inches of rain. Chincoteague reported the lowest pressure...29.28". The system helped ease drought conditions in Washington, D.C..

1954 October 15 (Hazel): On the 4th, a tropical storm moved through the Windward Islands into the Caribbean Sea. It quickly formed into a hurricane and continued on a westerly track until the 10th. An upper low in the western Caribbean steered Hazel northward through the Mona Passage on the 12th. As the hurricane did so, heavy rains caused mudslides in Haiti which killed 500 people. Its track became northwesterly as a cold front approached from the Mississippi Valley. The hurricane then accelerated into northeast South Carolina as a category four hurricane. On the 15th, it passed over Raleigh, Richmond, and West Virginia (track to the left).

Considerable damage was done to residential and business property in Washington as sustained winds peaked at 78 mph with gusts to 98 mph. At National Airport, a light plane flipped over and part of the hangar was blown away. The Weather Bureau radar had to be turned off for three hours when the motor began to heat up. As a cold front interacted with Hazel, a squall line swept through Washington, D.C. at 6:15 p.m., dropping the temperature 20 degrees in one hour. Frost was seen in the suburbs the following night.

Hundreds of trees fell across the Federal City. Many store front windows shattered. Falling trees damaged many houses in Fairfax. Winds whipped up white caps on the Potomac. Waters overflowed the seawall at Hains Point. Alexandria saw the Potomac flood reclaim two blocks of the city, flooding basements and first floors of businesses. U.S. 1 was flooding by 9 p.m. at Hunting Creek. Heavy rains fell in the mountains, with a couple locations measuring over 10 inches.

Norfolk's sustained winds reached at 78 mph with gusts to 100 mph. Hampton saw winds as high as 130 mph. Damage was extensive from strong winds and high tides. Several ships in the James River were sunk or wrecked. At the Old Dominion Boat Club in Alexandria, two cruisers sank and several docks washed away. Quantico saw most of its docks vanish. Fourteen sailboats met an untimely fate at the Washington Sailing Marina. Tides reached 8.7 feet above low water datum at Washington, D.C..

The battleship *Kentucky* broke its moorings and ran aground 100 feet away. The gun screw vessel *Pirate* was lost off West Norfolk. The Coast Guard beacon light on the Potomac at Morgantown was toppled by Hazel's winds. Thirteen across Virginia perished...2 in the District of Columbia ...damage estimates reached $15 million.

1955 August 12 (Connie): Connie developed in the tropical middle Atlantic on the 4th, and moved west northwest to the north of Puerto Rico. Motion slowed on the 9th, as Connie began to interact with the developing Hurricane Diane. On the 11th, the system accelerated north- northeast and hit Cape Lookout, North Carolina (track to the right). It crossed the coast near Norfolk, emerging back into the Atlantic. Heavy rains and high winds were seen from North Carolina northward into New England.

Winds picked up on the upper Chesapeake Bay at 4 a.m., reaching gale force by daylight. The *Levi J. Marvel* was fighting the storm. When winds reached 50 mph, the canvas sails tore away. Twenty to twenty-five foot swells tormented the ship near Holland Point and it broke anchor. She took on water and capsized around 2:40 p.m.. Eleven drowned. The oil screw *La Forest L. Simmons* capsized 1 ½ miles north of Sharps Island Light in Maryland.

Norfolk's pressure fell to 28.77". The highest wind gusts were seen at Chincoteague, where winds peaked at 64 mph. National Airport at Washington D.C. reported sustained winds of 49 mph, with gusts to 58 mph, and 4.57" of rain. Power lines went down around the District. Scores of trees fell. Dozens of basements were flooded by the heavy rains. Eastern Virginia saw eight to ten inches of rain with Connie. Due to a drought which preceded the storm, any flooding was of minor consequence. Tides peaked at 6.6 feet above low water datum at Washington, D.C.. Four died in Rock Creek during the storm.

1955 August 17-18 (Diane): The category one hurricane named Diane caused heavy rains, compounding the flooding caused by Connie not even a week earlier. As Connie moved out to the north, Diane followed the storm and also struck North Carolina (track to the left). It passed west of Danville at 6 p.m.. The lowest pressure seen across Virginia was 29.48" at Lynchburg. Winds gusted to gale force across eastern Virginia and Washington D.C.. Winds peaked at 45 mph at Chincoteague. In the tidewater of Washington D.C., tide were four feet above normal... the peak level was 7.1 feet above mean lower low water on the morning of the 18th. Persistent east and southeast winds over the Chesapeake led to this condition.

The heaviest rain fell across northern Virginia, where amounts totaled over six inches. Several locations on the eastern slope of the Blue Ridge mountains recorded over a foot of rain. Flood stages were reached at most points in the Potomac Basin. Tides peaked at 7.0 feet above low water datum at Washington, D.C.. However, the heaviest flooding occurred along portions of the Shenandoah River Basin. High tides were also experienced, in addition to the rains. Damage in Virginia totaled $10.7 million. This hurricane produced over $686 million in damage, mainly due to its disastrous floods across the East Coast.

1955 September 19-20 (Ione): Ione was a major hurricane as it approached the Mid-Atlantic. Originally expected to move through Washington, D.C., the storm veered off to the right, proving to be far less of a menace than anticipated (track above). Sustained winds at Norfolk peaked at 47 mph with gusts to 58 mph. The pressure bottomed out at 29.13" (986 hPa). Total rainfall from the hurricane was 3.5". This cyclone gave a scare to the Mid-Atlantic, before it veered out to sea.

1956 September 27 (Flossy): This hurricane formed in the Gulf of Mexico and left a path of destruction from the Mouth of the Mississippi river through the Florida panhandle, Georgia, and South Carolina. As a nontropical gale, the system alleviated drought conditions across the region. Shortly after midnight, winds peaked at 45 mph in Washington, D.C.. One thousand phones were dead due to disabled phone lines. Three inches of rain fell across Virginia. Some streets in Norfolk were flooded with 2 ½ feet of water (Barnes II). The Back River lighthouse collapsed during the storm. The gas screw vessel *Mary Anne* was lost at Hampton Roads Naval Base.

1958 September 27 (Helene): Maximum sustained winds at Norfolk peaked at 41 mph with gusts to 56 mph as this hurricane moved by to the southeast.

1959 July (Cindy): Winds at Norfolk peaked at 45 mph with gusts to 46 mph. Small yet violent tornadoes were spawned by Cindy in Norfolk and Portsmouth. Over four inches of rain fell in Hopewell.

1959 September 30 (Gracie): This tropical cyclone initially struck the Atlantic coast south of Charleston, and moved west of Charlotte into western Virginia (track above). A tornado (one of three) touched down eight miles west of Charlottesville, killing 11. Heavy rains were seen in the Appalachians and near Norfolk. Norfolk saw 6.79" of rain in twenty-four hours. In all, twelve perished.

1960 September 11-12 (Donna): From the beginning, Donna was a ferocious storm. On August 29th, squalls in the vicinity of Dakar, in the country of Senegal on the west coast of Africa, forced the crash of an airliner, killing 63 aboard. The system moved out in the Cape Verde Islands on the 30th, and arrived at the Leeward Islands on the 4th. Amazing flash flooding was seen across the Virgin Islands and eastern Puerto Rico, when up to 15 inches of rain fell in less than four hours. Winds gusted to 180 mph across the Florida Keys, as the hurricane turned northward.

Thereafter, Hurricane Donna affected the entire length of the Atlantic coast of the United States. Donna became the first hurricane since complete records were kept in 1871 which traversed the Florida peninsula, the southeastern Unites States, the Mid-Atlantic region and New England.Donna made a second landfall between Wilmington and Morehead City on the evening of the 11th as a category three hurricane. The system tracked across the Albemarle and Pamlico sounds of North Carolina and re-emerged into the Atlantic Ocean just southeast of Virginia Beach shortly after 5:00 AM September 12, 1960. Above is a list of the lowest pressure measured in the region during Donna.

Virginia Beach saw the pressure fall to 28.51"...and winds gusted to 89 mph. Maximum sustained winds reached 73 mph at Norfolk and 80 mph at Cape Henry. The Chesapeake lightship estimated 138 mph winds as the pressure dove to 28.65". Eastern Virginia saw the most rain...where six to eight inches fell. The vessels *Peggy* and *Tender* were wrecked off Norfolk. Three died in Virginia due to Donna.

1964 August 29-September 1 (Cleo): This hurricane passed through the inland sections of the state from west to east. Washington, D.C. could only watch it rain to the south, as record drought plagued the area throughout much of the summer and fall. Southern sections of the Old Dominion saw inundating rains. In Tidewater Virginia, ten to fourteen inches of rain fell in about 12 hours. Two perished...both deaths were caused by motorists, who after being stranded in flood waters, were poisoned by carbon monoxide. Damages totaled $3 million.

1964 September 11-14 (Dora): As Dora moved northeast from Cape Hatteras out to sea 120 miles southeast of Norfolk, its influence was felt across southeast Virginia. Tides of three feet above normal in Hampton Roads caused moderate flooding of low lying areas. Heavy rain led to flooding at Suffolk and Yorktown. The heaviest rain was seen at Diamond Springs, 5.83 inches. Norfolk saw winds peak at 63 mph, causing minor damage. Near Cape Henry, a large freighter was driven aground.

1967 September 9-11 & 15-18 (Doria): An extreme example of how erratic a path of a hurricane can be, it remained near the southeast coast of the United States for 13 days, moving different directions every few days. As a hurricane on the 13th, it moved westward. The storm made landfall near the Virginia Capes before meandering south for a brief skirmish with North Carolina on the 17th, then eastward back out to sea.

Two periods of rain were associated with Doria in Virginia. The highest amount recorded was 4.66" at Lake Drummond, near Wallaceton. As the storm passed offshore the Virginia Capes by 225 miles on the 10th and 11th, winds gusted to a mere 36 mph at Norfolk. Cool air invaded the Mid-Atlantic. Washington, D.C.'s temperature fell to 49 degrees on the 11th.

The second approach on the 15th and 16th caused winds to gust to 55 mph...the pressure fell to 29.60" at Norfolk. Gusts to 60 mph were seen at Wallops Island on the 16th. Torrential rains and squalls buffeted the Eastern Shore. Winds damaged trees, roofs, signs, and billboards. Twenty to thrity foot seas came in advance of Doria's second coming towards Virginia. The superstructure of a 38-foot boat was torn off by high seas off the Atlantic coast near the Virginia/Maryland border...three perished from the vessel (Bailey). Tides were four feet above normal at Virginia Beach.

1969 August 19-20 (Camille): One of the strongest hurricanes ever recorded, Camille became Virginia's worst natural disaster ever. Camille weakened as it moved through the Southeast...until reaching the Appalachian mountains. As a cold front approached from the northwest, a burst of heavy rains developed across southeast West Virginia and western Virginia. To the right is a NIMBUS III satellite image of Camille just offshore the Mid-Atlantic on the 21st, provided by NCDC.

A band of rain and thunderstorms about 45 miles wide stretched from White Sulphur Springs, West Virginia to Fredericksburg. Rainfall increased rapidly along the west slopes of the Blue Ridge mountains; more than ten inches fell at Clifton Forge. In Nelson county, one location reported a whopping 27" of rain in only eight hours. This caused 133 bridges to be wiped out throughout Nelson county, making transportation nearly impossible. As Camille intensified back into a tropical storm over Virginia, four inches of rain fell along the coastal plain, in the path of the redeveloping storm.

When the rains began in earnest, telephone lines were downed, preventing the true nature of the flooding to the known until much later. Extensive flash flooding and landslides caused a major disaster on the Tye and Rockfish river basins. Landslides swept into hollows, destroying roads, homes, bridges, and railroads. Charlottesville was isolated as rock and mud slides blocked roads.

The James River experienced a flood of record as far downstream as Richmond. To the right is a table of values for different locations within the James River system. Buena Vista had 5 ½ feet of water in its business district. Glasgow, at the confluence of the Maury and James rivers, saw its entire business district destroyed by water nearly 14 feet deep. Flash flooding caused 153 people to perish, mainly across Virginia. The oil screw *Leader* foundered four miles east of Cape Henry. Damage totaled $113 million.

1970 May 26-27 (Alma): On the subsident side of the cyclone, at 1:15 p.m. on the 27th, a strong dust devil at Radford picked up a roof of a school hallway and dumped it onto the school grounds, injuring six.

1971 August 27 (A second Doria): A weak tropical depression formed in the eastern Atlantic and moved swiftly to the west, passing through the northern Leeward Islands on the 23rd, and moving just to the east of the Bahamas on the 25th. While recurving to the north, Doria became a tropical storm and continued to intensify as it approached the coast. Maximum sustained winds were 65 mph with the system as it made landfall in North Carolina (see track below).

Maximum sustained winds were 52 mph at Norfolk, 59 mph at Wallops Island, and 60 mph at Langley Air Force Base. A large warehouse near the Norfolk airport experienced severe damage. Appreciable losses were caused by a tornado as it tracked through Portsmouth and Chesapeake. Hundreds of trees fell and a dozen homes were damaged.

The highest rainfall amount was 6.44" two miles south-southeast of Halifax. Four-Mile Run flooded once more. A sewage plant in Virginia Beach became clogged with silt and sand. When the sewage was dumped into the Chesapeake, beaches were closed for days. A young girl drowned in Alexandria, when she fell into a drainage ditch.

1971 September 30-October 3 (Ginger): Tracked for 31 days as a cyclone through the Subtropical Atlantic, the very long-lived Ginger tormented Bermuda twice before moving west into North Carolina near Atlantic Beach. Maximum winds were under 50 mph across southern Virginia. Norfolk gusted to 49 mph from the northeast on the 30th. A few trees were leveled with isolated utility outages leading to minor inconvenience. The heaviest rains from the decaying tropical storm were seen in southeast Virginia. Diamond Springs reported a 7.49" deluge of rain. Tides ranged from two to four feet above normal. Moderate to heavy beach erosion ate away at Virginia Beach.

1972 June 21-22 (Agnes): Developing near the Yucatan peninsula of Mexico on the 15th, Agnes turned north and on the 16th attained hurricane status in the east-central Gulf of Mexico. A category one hurricane when it struck the Florida panhandle on the 17th, the storm weakened as it moved up the coast, east of the Appalachians. Pressures fell to 29.10" at Norfolk. Langley Air Force Base experienced wind gusts to 54 mph.

Big Meadows totaled 13.6" of rain from the decaying storm. The highest amount measured was 16" at Chantilly (See rainfall map to the upper right). An all-time 24 hour precipitation was set at Dulles Airport, when 11.88" deluged the area (Kocin). Associated severe flooding caused record river stages along the east half of the James River basin. Floods of record were recorded at Cartersville (37.87 ft.), the Richmond City Locks (36.5 ft.), and Richmond near Westham (28.62 ft.). This flood caused the James to swamp a 200 block area of downtown Richmond, the worst flooding since May 1771. Only one of the five bridges across the James was left usable. Moderate flooding occurred at Buena Vista.

Near Alexandria, Four Mile Run flooded the heavily populated section of Arlandria. Flooding was also severe along the Appomattox River Basin. The entire Potomac also flooded. Along the Potomac, 66 miles of towpath were scoured by the floods. Inundation led to a 300- foot cave-in at the Widewater section of the C & O Canal. Thousands of homes were flooded in Washington, D.C.. Even the White House experienced the wrath of Agnes, when heavy rains invaded its basement. Around 49,000 phones were put out of commission by downed lines. In the D.C. metropolitan area, ten people fell victim.

One hundred three highways were either destroyed or damaged across the state. The shellfish and oyster industry suffered due to excessive fresh water runoff into the Chesapeake destroying their marine habitat for weeks. Damage done across the state from Agnes totaled $222 million....$25 million in Fairfax county alone. The C & O Canal saw $34 million in damages. Thirteen died from flash flooding in Virginia.

As the storm moved northeast through New York, destructive floods and tornadoes surged the damage total to over $2.3 billion for the United States. The worst floods on record were experienced across Pennsylvania and southern New York, as over sixteen inches of rain fell in several locations.

1975 September 24-26 (Eloise): After striking the Florida panhandle as a major hurricane, Eloise accelerated inland and was downgraded to a tropical storm in Alabama (track above). Heavy rains began to fall across the Mid-Atlantic as Eloise interacted with a cold front. Street flooding was rampant in Virginia and Washington D.C.. The 9.08" of rain seen at Washington, D.C. from the cyclone led to the wettest September at the site since 1934. Flooding was experienced along the Patuxent River and Four-Mile Run. Arlandria experienced such a flood that 400 residents evacuated during the night of the 25/26th ($11.9 million).

Forty residences were submerged near Manassas, on Bull Run. Rock Creek Parkway was closed due to mud slides. Nearly 300 secondary and thirteen primary roads were closed due to the flooding statewide. Damage totaled $17.2 million.

1976 August 9 (Belle): A tropical wave moved offshore Africa on July 28th and moved uneventfully across the Atlantic and Caribbean Sea. A tropical depression formed on the north end of this wave on the 6th, in the vicinity of the northern Bahamas. Belle rapidly developed into a hurricane on the 7th. On the 8th, the system accelerated northeast and it made its closest approach to North Carolina on the 9th. It passed 85 miles east of Norfolk at 1 p.m. EST. Later that day, the fast moving storm made landfall on the coast of western Long Island.

Although on the weak west side of this hurricane, Virginia noted the passing of Belle. Pressures fell to 29.44" at Wallops Island...where winds of 60 mph were seen in gusts. Over four inches of rain fell along the immediate coast of Virginia. At South Island along the CBBT, winds peaked at 63 mph. One died in a related traffic accident in Norfolk.

1979 September 5 (David): David was a classic Cape Verde hurricane which caused massive destruction along its path across the western Atlantic. Dominica was the first island to experience David. Almost three-fourths of the population was left homeless by the cyclone. It was their strongest hurricane since 1834. As it moved westward across Puerto Rico, $70 million in damages was exacted from the island. Haiti was devastated the most by the borderline category 5 hurricane when heavy rains, mud slides, and high winds led to over 1,200 lost lives. Entire villages were swept away be the epic flood; the tempest caused $1 billion in damage across Hispaniola.

As the menacing storm continued its parabolic course, a brief landfall occurred at West Palm Beach. Now moving northward, the system moved just inland of the Atlantic Seaboard after its final landfall near Hilton Head, SC. When squalls passed through Virginia on the 5th, two powerful tornadoes tracked through Newport News and Hampton, causing $2.5 million in damage.

Most damage across the area was produced by gusty winds, as high as 60 mph. Trees and power lines were no match for David; this led to 140,000 people without power. A tornado touched down at the edge of Fairfax City at 7:22 p.m. on the 5th, severely damaging 22 homes ($2 million damage). This tornado lifted briefly, before touching back down at Great Falls. Eight tornadoes touched down from Fairfax and Loudon counties south to Newport News.

Many funnel clouds and weak tornadoes played havoc with Washington, D.C.. Winds only gusted to 39 m.p.h at National Airport; rains at that location totaled 3.68". Flooding was seen along Rock Creek, leading to the road's undermining ($374,000 damage). Floods also invaded the Alexandria waterfront. Heavy rains fell across the mountains of western Virginia and also in the vicinity of Norfolk. Big Meadows recorded 8.93" on the 9th while nine inches fell at Poor Mountain, near Roanoke. Flooding began around 9 p.m., inundating Colonial Heights-Petersburg, Rappahannock, Page, Madison, and Orange counties. Three perished in the storm. Total insured losses to the D.C. metropolitan area reached $8 million.

1985 July 25 (Bob): A tropical depression formed in the southeast Gulf of Mexico. It slowly meandered east, becoming a tropical storm just prior to making landfall across southwest Florida. As the system reached the east coast, it turned to the north. Hurricane status was achieved to the east of Georgia. The cyclone moved north into South Carolina, weakening quickly back into a tropical depression.

As the low moved north through Virginia, Bob spawned two weak tornadoes of F0 intensity and one strong tornado of F3 intensity. The two weak tornadoes near Richmond and Charlottesville damaged ten houses. The strongest tornado in northern Albermarle country destroyed two homes. Funnel clouds were observed throughout the Washington, D.C. metropolitan area. Gusty winds downed power lines, disrupting the Boy Scout jamboree in Fredericksburg. Winds peaking at 48 mph at National Airport downed a seaplane in the Washington Channel, near Hains Point, shortly before 2 p.m..

High winds and heavy rains damaged trees and led to a loss of power to 30,000 throughout the D.C. suburbs of Virginia and Maryland. A house under construction in Great Falls collapsed. Two people were fatally injured in Germantown, MD when a car slid into another vehicle while attempting to enter a curve. In the District, a man perished when his van struck an eastbound car. At 2 p.m., a car accident claimed a life near Calverton, MD.

1985 September 27 (Gloria): For ten days, this system gained intensity as it moved across the Atlantic, becoming an extremely dangerous and large category four hurricane east of the Bahamas (track to the left). As the storm accelerated north, cooler water temperatures caused weakening of the once powerful hurricane. Still, Gloria moved over Cape Hatteras at 2 a.m., where a pressure of 27.98" was achieved.

Virginia Beach saw the pressure bottom out at 28.87". Norfolk experienced winds sustained at 46 mph, with gusts to 67 mph. Norfolk Naval Air Station reported wind gusts of 64 mph. Sustained winds of 94 mph, with gusts to 104 mph, blew through South Island's Chesapeake Bay Bridge Tunnel (CBBT).

Hampton Roads saw a 5.65" deluge of rain. Southeast Virginia measured the most rain; isolated locales saw over eight inches. The highest tide noted was 5.3 feet above mean lower low water. Damage totaled $5.5 million statewide. This storm became nontropical in Canada and continued to rapidly move east. A record warm spell greeted Europe as Gloria made landfall on the continent early in October.

1985 November 2-7 (Juan/"Killer Flood of 1985"): This hurricane of non-tropical origin drifted aimlessly across Louisiana during the last week of October before moving east into Pensacola on Halloween. As the center of Juan moved north towards Michigan, a secondary low moved east across North Carolina, continuing the moderate rains. A third low pressure system, along Juan's cold front, transformed a minor flood into a major disaster. A massive rain shield developed as warm, tropical air overrode cooler air to the north of the center. This third system tracked across southwest Virginia on the 4th, and eventually through northern Virginia and Maryland.

Heavy rains fell across the eastern slopes of the Blue Ridge mountains...19.77" two miles northeast of Montebello. The Bloomington Reservoir rose 80 feet in a mere 30 hours. It was considered more damaging, further upriver than Agnes was in 1972. Record-breaking flood discharges occurred at many locations within the Potomac, James, and Roanoke river basins (Carpenter). The heart of the destruction was across Virginia and West Virginia. In Virginia, 3500 homes were destroyed. Carpeting, dead animals, window frames, and numerous household items began flowing down the Potomac. The most extensive damage in the Old Dominion occurred in the Roanoke river basin, in the Roanoke-Salem metropolitan area. Many in Roanoke were rescued from rooftops via boats and helicopters. Waters rose to the third story of an apartment complex in Salem. Lynchburg experienced the James rising to seven feet above the previous record, set in 1877. Stored tobacco was in ruin; losses totaled $8 million. Extensive flooding invaded Richmond. Monetary losses exceeded those of Camille and Agnes. Forty counties and twelve independent cities were declared Federal disaster areas.

Waters rose to within two inches of the top stones of Georgetown's Lock 3, stopping just shy of a catastrophe for Washington, D.C.. Waters were high for four days. Total damages along the C & O Canal from Cumberland to Georgetown was over $9 million. Overall, the Potomac saw $113 million in damages. In Virginia, 22 perished and $753 million of damage was incurred. In West Virginia, almost 2600 residents were left homeless after the floods, and damages skyrocketed to $500 million. It was the worst flood in West Virginia history as several small towns were almost destroyed (Stanton). Total damage across West Virginia, Virginia, Pennsylvania, and Maryland totaled $1.4 billion.

1986 August 17 (Charley): Forming as a tropical depression over the northeast Gulf of Mexico, the system wandered east and northeast to off the South Carolina coast before finally becoming a tropical storm. (track above and below). Charley briefly became a hurricane immediately off the Mid Atlantic coast. Norfolk saw winds of 40 mph, gusting to 63 mph. Cape Henry experienced sustained winds of 54 mph with gusts to 82 mph. South Island's CBBT saw hurricane conditions as 94 mph sustained winds, with gusts to 104 mph, lashed the station.

A light twin engine plane crashed into the Chesapeake Bay at around 7 p.m., killing all three aboard. Tides rose to 5.5 feet above mean lower low water. Damage totaled less than $1 million statewide.

1989 September 21-22 (Hugo): Hugo was a well organized tropical disturbance as it emerged off the coast of Africa. It developed modestly as it crossed the ocean and became a category five hurricane as it approached the northeastern Caribbean Sea. Puerto Rico took its toll on Hugo (and vice versa) and Hugo weakened into a minor hurricane. Over the next few days, the system re-attained hurricane status and strengthened rapidly in the hours before landfall near Charleston. The track of Hugo then took a northward turn, across western Virginia, before transitioning into a nontropical low (track to the upper right, satellite picture to the upper left provided by NCDC). Winds peaked at 37 mph at National Airport. The low pressure system later merged with a cold front. Six died in Virginia due to Hugo.

1990 October 11-13 (Klaus & Marco): Klaus, once a hurricane northeast of the Caribbean, moved west-northwest to the north of the Greater Antilles as a weakening, sheared tropical storm. At this time, Marco was forming in the Florida Straits. The two low pressure systems moved in tandem on opposite sides of the Florida peninsula. The remains of Klaus came ashore along the east coast, accelerating northward into the Appalachians. Meanwhile, Marco limped ashore the Florida panhandle and moved slowly northeast. The combination of these two systems dropped around eight inches of rain to the mountains of western Virginia.

1994 August 17-18 (Beryl): This tropical storm formed very close to the Florida panhandle on the 14^{th}. Landfall took place near Panama City at 8 p.m. EST on the 15^{th}. Thereafter, the cyclone weakened to a tropical depression and moved northeast. Around five inches of rain fell across western Virginia. Heavy rains spread northeast to New York state. One tornado touched down just north of Ridgeway and tracked 4 1/4 miles. One hundred homes and thirty businesses were damaged along its path, and ten people were injured ($8.7 million).

Seven inches of rain fell in Carrol and Grayson counties, flooding roads and low bridges. Flood waters on Kerrs Creek sent one family evacuating. Evacuations also took place near the New River in Pulaski county. Roads in western Augusta county were closed. Faquier county saw mud and gravel slides damage and close roads. Over twenty roads were flooded in Shenandoah county. Winchester was inundated in a foot and a half of standing water. Damages totaled $15 million statewide.

1995 August 6-7 (Erin): The remains of Erin spread eastward from the Ohio Valley across West Virginia, northern Virginia, and Maryland. Almost six inches of rain fell in some areas of extreme northwest Virginia. It caused brief relief from an otherwise excessively hot and dry July, August, and early September. A tornado was spawned near the Patuxent Naval Research Center.

1995 October 5 (Opal): After accelerating northward out of the Gulf of Mexico, Opal moved quickly through the Eastern United States. The satellite picture to the left was taken as the cyclone was accelerating through northwest Gerogia at 4 a.m. on the 5th, provided by NCDC. Despite hundreds of miles of travel from the Gulf of Mexico, gale force winds blew through western Virginia. Winds sustained at 40 mph, with gusts past 60 mph, blew down trees mainly above 2000 feet elevation in the Shenandoah Valley and along the Allegheny Plateau. Dozens of trees were blown down along Skyline Drive in Page and Warren counties.

In Waynesboro, a canopy over a service station was ripped off. South Winchester and Elkton saw 2600 homes and businesses without power as lines were downed by the winds. Two tornadoes struck the tidewater. One touched down at West Point airport in New Kent county. It tore the roof off a hangar, destroying a small airplane and damaging four others. The second tornado uprooted trees and damaged outhouses.

In Madison county, five inches of rain fell on Graves Mountain, washing out a bridge previously destroyed by floods that June. A minor mudslide occurred in Grayson county. A vehicle was swept off the road by flood waters six miles southwest of Fancy Gap in Carroll county. Washington, D.C. saw local street flooding from the system's rainfall. Four to eight inches of rain fell across southwestern Virginia. This helped end drought conditions brought on from a very dry July, August, and September. Damage totaled $220,000.

1996 July 12-13 (Bertha): The earliest Cape Verde hurricane ever witnessed to cross the Atlantic unscathed, unprecedented Bertha lashed the Mid Atlantic coast (track below). To the right is an image of the hurricane as it was making landfall in North Carolina, provided by the National Climatic Data Center (NCDC). Portsmouth reported winds gusting to 54 mph on the 13^{th}... the pressure fell to 29.37". Tree limbs falling on power lines caused temporary power outages. Over four inches of rain fell across southeastern Virginia.

1996 September 5-8 (Fran): The major hurricane known as Fran struck the North Carolina coast between Wrightsville and Topsail beaches (track to the upper left, satellite picture to upper right courtesy of NCDC). Extensive flooding was endured from North Carolina and Virginia northward, as the center passed over Danville. Widespread flooding occurred in the mountains. Norfolk saw southeast winds of 41 mph, with gusts to 47 mph. At Portsmouth, winds peaked at 60 mph at 4:19 a.m.; the pressure fell to 29.67". The storm raged more severely at Hampton, where gusts to 71 mph occurred.

Lynchburg experienced a 6.94" deluge of rain. Tom's Branch received 14.3"...causing flash flooding which cut the city off from the rest of the area. The town of Luray was split in half by flooding. Columbia saw winds of 46 mph. In all, 360,000 lost power due to the cyclone. In Washington, D.C., power lines and trees were downed. Fourteen inches of rain fell in isolated locations southwest of the city. To the left is a picture of flooding in Alexandria, courtesy of the Associated Press. Along the C & O Canal, the devastating flood swept through Harpers Ferry and Point of Rocks. A Virginia woman perished as her all-terrain vehicle was swept away, while crossing a flooded creek. Three perished due to Fran.

1997 July 24 (Danny): This hurricane made landfall in southeast Louisiana before stalling in Mobile Bay for over 24 hours. Thereafter, it moved north into western Alabama before making a hard right towards the east across the lower Appalachians. While the system was in transit across the length of North Carolina, it restrengthened into a tropical storm. It later emerged into the Atlantic near Pungo, Virginia.

The pressure fell to 29.73" at Portsmouth as winds gusted to 56 mph at 3:17 p.m.. Norfolk Naval Air Station experienced wind gusts to 67 mph. Langley Air Force Base, the Chesapeake Bay Bridge Tunnel, and Cape Henry gusted to 61 mph. Trees and power lines were downed throughout the Norfolk metropolitan area. At 1:09 p.m., a tornado touched down in the South Norfolk section of Chesapeake or about two miles east of Portsmouth and destroyed a car wash, along with six other businesses. A tractor trailer was overturned. Another tornado near Norfolk destroyed windows and tracked a mile east across the eastern branch of the Elizabeth River. A third tornado touched down at Knotts Island.

1998 August 27-28 (Bonnie): This hurricane formed in the tropical Atlantic before recurving to move over the Outer Banks. Portsmouth gusted to 63 mph while the pressure fell to 29.53". Norfolk experienced winds of 46 mph with gusts to 64 mph. Winds howling to 90 mph blew past the Cape Henry Light Station. South Island CBBT had 90 mph with gusts to 104 mph. The combination of four to seven inches of rain and high winds knocked out power to nearly 1,000,000 people...most of which were in the vicinity of Hampton Roads. Tides peaked at 6.0 feet above mean lower low water.

1999 August 29-September 7 (Dennis): On the 22nd, a tropical disturbance formed north of Puerto Rico. Over the next two days, the system gradually became a tropical depression while located near the southeasternmost Bahamas. Strengthening was slow to ensue to to upper level westerly winds inhibiting development. Despite the shear, Dennis became a tropical storm on the night of the 24th, as it drifted west-northwest.

The cyclone was in a state of constant reorganization through the 26th, but slowly intensified into a hurricane by that morning while located in the central Bahamas. An upper level trough swung through the northern Plains and into the Northeast over succeeding days. This allowed the storm to turn slowly to the north, while continuing to strengthen. It came perilously close to Wilmington, North Carolina during the night of the 29th before finally moving northeast, paralleling the coast. To the left is a satellite picture showing this hurricane near the time of its closest first approach, at 11:15 a.m. on the 30th.

Cold and dry air began to envelop the system during the night of the 30th, leading to a collapse of all the deep convection (thunderstorm activity) around the system. Weakening began soon after, returning to category one status by the morning of the 31st, and a tropical storm late that night. Showers and thunderstorms temporarily redeveloped each day, keeping the system at tropical storm strength. The cyclone then meandered slowly west from the 1st through the 3rd...before accelerating during the day of the 4th into southeast North Carolina, as it reintensified into a strong tropical storm. After landfall that night, Dennis moved westward into central North Carolina, finally reaching the Old Dominion late on the night of the 5th as a weakening tropical depression. On the 6th, it accelerated northward across the state.

Gale-force winds were experienced along the coasts of North Carolina and Virginia from the night of the 29th through the 31st. On the 4th, gusts to gale force redeveloped along the Virginia coast. As the center approached North Carolina, a tornado touched down in Chesapeake at 11:15 a.m. on the 4th, damaging two buildings. The second tornado, in Hampton at 1:21 p.m. was the most menacing. Ten cars and an eighteen-wheel truck overturned.

Three nursing and retirement homes were struck...sending their residents for safer shelter. Many homes lost their roofs. Six people were injured from this tornado.

Rainfall amounts for the past week in southeast Virginia approached seven inches for the entire event. The highest rainfall total reported was 9.25" at Upper Shernando. As of 1 a.m. on the 6th, Apple Orchard Mountain in Bedford county had measured 8.83". Other locations that measured over seven inches of rain included Monterey, Toms Branch, Montebello, Sugar Grove, and Big Meadows. The tropical deluge affected areas from North Carolina northward to Pennsylvania, as of the 6th. High tides invaded Norfolk/Virginia Beach by the morning of the 31st...3.1 feet above normal at 8 am on the 31st, but they slowly receded over following days.

The highest gust reported in Virginia was 54 mph at Norfolk Naval Air Station at 5:06 p.m. EDT on the 30th. The lowest pressure seen in the Old Dominion thus far has been 29.77" at Norfolk at 4:25 p.m. on the 4th.

1999 September 16 (Floyd):. Passed directly over Virginia Beach on a track similar to Hurricane Donna in1960. Lowest pressure of 28.85" (977 MB) at Norfolk Int'l Airport 4th lowest for a hurricane this century. Fastest 1 minute wind NE 31mph with gust to 46 mph. Rainfall 6.80" with amounts of 12-18" in interior portions eastern Virginia. Franklin, VA reported 500 year flood of record. Largest peacetime evacuation in U.S. History.

TWENTY-FIRST CENTURY

2003 September 18 (Isabel): Made landfall near Ocracoke NC. The center passed west of Emporia and west of Richmond. Fastest 1 minute wind speed NE 54 mph with gusts to 75 mph at Norfolk NAS; NE 61 mph with gusts to 74 mph at the South Island CBBT. Highest tide at Sewells Point was 7.9 feet above MLLW, which was a 5 ft surge. Significant beach erosion was reported. Numerous trees and power lines down over a wide area, with over 2 million households without power in VA. VA damage was over $625 million, and there were over 20 deaths in VA.

2004 August 3 (Alex): made its closest approach to land on August 3, 2004 with its center located about 9 nm southeast of Cape Hatteras/Outer Banks, NC as a Category 1. Alex produced locally heavy rainfall across portions of southeast Virginia, but little in the way of damage or flooding.

2004 August 14 (Charley): made a second landfall near Cape Romain, SC as a weakening Category 1, after devastating portions of central and southwest Florida. Charley brought locally heavy rainfall and strong winds to much of southeast Virginia, especially near the coast. A wind gust to 72 mph was recorded at the Chesapeake Light buoy. In the U.S., 10 deaths and $14 billion in damage resulted from Charley.

2004 August 30 (Gaston): made landfall near Awendaw, SC, on August 29, 2004 as a Category 1. Gaston weakened as it lifted northward through North Carolina, then northeastward across southeast Virginia on August 30th. Gaston produced a swath of 5 to 14 inch rains extending from Lunenburg and Mecklenburg counties northeast into Caroline and Essex counties. The heaviest rainfall, centered on the Richmond metro area, produced a major flash flood which killed 8 people. Five of these deaths resulted from people driving into flooded roadways. A total of 13 tornadoes were observed in central and eastern Virginia, all producing F0 damage. Total damage is estimated at $130 million.

2004 September 8 (Frances): made landfall over east central Florida as a Category 2. It then moved northeast into the northern Gulf of Mexico, eventually turning north, making a second landfall in the panhandle of Florida, and then weakening into a tropical depression. It tracked through western Virginia, then northeast and offshore the mid Atlantic coast. A total of 6 tornadoes were observed in central and eastern Virginia, the strongest producing F1 damage.

2004 September 17 (Ivan): made landfall near the Florida/Alabama border as a category 3. It weakened to a tropical depression, and moved northeast, tracking along the Appalachian Mountains through western Virginia, then northeast and offshore the mid Atlantic coast. A total of 40 tornadoes were produced in Virginia, most in central and northern Virginia. This was a record single day outbreak for Virginia, and exceeded the previous ANNUAL tornado record (31). Most of these tornadoes were F0 or F1 in intensity, although 10 F2 tornadoes and 1 F3 tornado touched down in south central…west central and northern Virginia.

Hurricanes come close enough to produce hurricane force winds approximately three times every 20 years. Two or three times a century winds and tides produce considerable damage and significantly threaten life. Three known storms have been powerful enough to alter coastal features.

MLLW = Mean Lower Low water which is the mean of the lowest of the low tide values.

Bibliography for Appendix C

Assataeague Naturalist. The Great Hurricane of 1933. World Wide Web, 1998.

Bailey, Morton H.: "Special Weather Summary" Climatological Data Virginia : September 1967. Environmental Science Services Administration: Asheville, 1967.

Barnes, Brooks M., Barry R. Truitt. Seashore Chronicles: Three Centuries of the Virginia Barrier Islands. University Press of Virginia: Charlottesville, 1997.

Barnes, Jay. North Carolina's Hurricane History. University of North Carolina Press: Chapel Hill, 1995.

_____. Florida's Hurricane History. University of North Carolina Press: Chapel Hill, 1998.

Carpenter, D. H.. Floods in West Virginia, Virginia, Pennsylvania, and Maryland, November 1985. U.S. Geological Survey Water-Resource Investigations Report 88-4213: Towson, 1990.

Cobb, Hugh D. "The Chesapeake-Potomac Hurricane of 1933" Weatherwise: Heldref Publications: Princeton, 1991.

Crappuli, Robert. Hurricane and Tropical Storm Data: 1600-present...Georgia and South Carolina Storms. World Wide Web, 1998.

Crockett, Curtis W.: "Special Weather Summary" Climatological Data Virginia: August 1971. Environmental Data Service: Asheville, 1971.

Environmental Science Services Administration. Hurricane Camille: August 14-22, 1969. Department of Commerce: Washington D.C., 1969.

Fernandez-Partagas, J., Henry Diaz, 1996. A Historically Significant Revision of Atlantic Tropical Cyclone Frequency 1851 to 1890. Climate Diagnostics Center, ERL/NOAA, 62 pp.

Green, Timothy. "Frederickfburg, July 31" Virginia Herald and Fredericksburg Advertiser 31 July 1788: 3. _____. "Frederickfburg, August 7" Virginia Herald and Fredericksburg Advertiser 7 August 1788: 3. _____. "Fredericksburg, August 4" Virginia Herald, and Fredericksburg Advertiser 4 August 1795: 3. _____. "Norfolk, August 12" Virginia Herald, and Fredericksburg Advertiser 21 August 1795: 2.

Henry, Alfred J.. "Climatological Tables" Monthly Weather Review August 1928. Government Printing Office: Washington, 1929.

High, Mike. The C & O Canal Companion. Johns Hopkins University Press: Baltimore, 1997.

House, Donald C. The Virginia Floods: August 19-22, 1969. Environmental Science Services Administration: Washington D.C., 1969.

Hutchins, Stilson. "Very Welcome Rain" Washington Post 10 September 1881: 1. _____. "The Coming Cold Wave" Washington Post. 11 September 1881: 1. _____. "Damage by the Storm" Washington Post 12 September

1882: 3. _____. "Alexandria Annals" Washington Post 13 September 1882: 3. _____. "A Destructive Storm" Washington Post 24 September 1882: 1. _____. "The Equinoctial" Washington Post 25 September 1882: 1.

Hutchins, Stilson. "Welcome Rain in Virginia" Washington Post 12 September 1883: 1. _____. "Wreck of the Norfolk and Western" Washington Post 13 September 1883: 1. _____. "Virginia Peanuts a Failure" Washington Post 16 September 1883: 1. _____. "A Widespread Storm" Washington Post 26 August 1885: 1. _____. "Panic on a Steamer" Washington Post 27 August 1885: 1. _____. "A Widespread Storm" Washington Post 14 October 1885: 5.

Jennings, Arthur H. Technical Paper No. 16: Maximum 24-Hour Precipitation in the United States. Hydrologic Services Division: Washington D.C., 1952.

Kocin, Paul J. Tropical Cyclones in the Northeast United States. Unpublished: Camp Springs, 1995.

Kutschenreuter, Paul H. Technical Paper No. 26: Hurricane Rains and Floods of August 1955 Carolinas to New England. Department of Commerce: Washington D.C., 1956.

Lewis, Clifford M., Albert J. Loomie. The Spanish Jesuit Mission in Virginia 1570-1572. University of North Carolina Press: Chapel Hill, 1953.

Ludlum, David M. Early American Hurricanes: 1492-1870. American Meteorological Society: Boston, 1963. _____. Weather Record Book. Weatherwise: Princeton, 1971.

Morton, Robert A. An Overview of Coastal Land Loss: With Emphasis on the Southeastern United States. USGS Open File Report 03-337. Online at: http://pubs.usgs.gov/of/2003/of03-337/waves.html.

National Climatic Data Center. May 1970 Storm Data. NESDIS: Asheville, 1970. _____. August 1971 Storm Data. NESDIS: Asheville, 1971. _____. September 1971 Storm Data. NESDIS: Asheville, 1971. _____. June 1972 Storm Data. NESDIS: Asheville, 1972. _____. September 1975 Storm Data. NESDIS: Asheville, 1975. _____. August 1976 Storm Data. NESDIS: Asheville, 1976. _____. September 1979 Storm Data. NESDIS: Asheville, 1979. _____. August 1994 Storm Data. NESDIS: Asheville, 1994. _____. October 1995 Storm Data. NESDIS: Asheville, 1996. _____. July 1997 Storm Data. NESDIS: Asheville, 1996.

NWSO Wakefield, VA. The Hurricane History of Coastal Virginia. National Weather Service: Wakefield, 1998. _____. The Hurricanes of the 1930s in Virginia and North Carolina. World Wide Web, 1998. _____. The Hurricanes 1950-1954 in Virginia and North Carolina. World Wide Web, 1998.

Office of Meteorological Operations. Hurricane Agnes: June 14-22, 1972. National Weather Service: Silver Spring, 1972. _____. Hurricane Fran. National Weather Service: Silver Spring, 1996.

Pouliot, Richard A., Julie J. Pouliot. Shipwrecks on the Virginia Coast and the Men of the United States Life-Saving Service. Tidewater Publishers: Centreville, 1986.

Proctor, John Clogett. "New York Avenue Church" Sunday Star 21 March 1948: Washington. _____. "Storm Fury Faced By Churches Here" Sunday Star 30 September 1934: Washington.

Richards, George and Company. Virginia Journal and Alexandria Advertiser 6 October 1785: Alexandria, 3.

Ryan, Bob. Bob Ryan's 1991 Weatherwise Almanac. WRC-TV: Washington, 1991.

Secretary of the Army. Washington, D.C., Metropolitan Area: Letter from the Secretary of the Army Transmitting a Letter From the Chief of Engineers, Department of the Army, Dated April 28, 1964, Submitting a Report, Together

With Accompanying Papers and an Illustration, on an Interim Hurricane Survey of Washington, D.C., Metropolitan Area, Authorized by Public Law 71, Eighty-Fourth Congress, Approved June 15, 1955. U.S. Government Printing Office: Washington, 1964.

Shomette, Donald G. Shipwrecks of the Chesapeake: Maritime Disasters on Chesapeake Bay And Its Tributaries, 1608-1978. Tidewater Publishers: Centreville, 1982.

Stanton, Richard L. Potomac Journey: Fairfax Stone to Tidewater. Smithsonian Institution Press: Washington, 1993.

Stevenson, James D. A Historical Account of Tropical Cyclones that Have Impacted North Carolina Since 1586. NOAA Technical Memorandum NWS ER-83: Bohemia, 1990.

Tannehill, Ivan R. Hurricanes. Princeton University Press: Princeton, 1943.

Trotter, William. Hurricane Bertha Storm Report Portsmouth, Virginia. PWRS: World Wide Web, 1996. _____. Hurricane Fran Storm Report Portsmouth, Virginia. PWRS: World Wide Web, 1996. _____. Tropical Storm Danny Visits Portsmouth! PWRS: World Wide Web, 1997. _____. Hurricane Bonnie 1998! PWRS: World Wide Web, 1998.

U.S. Department of Commerce. Weather Bureau Technical Paper No. 2: Maximum Recorded United States Point Rainfall. Weather Bureau Analysis Center: Washington, D.C., 1947. _____. Climatological Data Virginia: September 1959. Weather Bureau: Asheville, 1959. _____. Climatological Data Virginia: October 1959. Weather Bureau: Asheville, 1959. _____. Climatological Data Virginia: August 1964. Weather Bureau: Asheville, 1964. _____. Climatological Data Virginia: September 1964. Weather Bureau: Asheville, 1964. _____. Hurricane Cleo: August 20-September 4, 1964. Weather Bureau: Washington D.C., 1964. _____. Climatological Data Virginia: September 1971. Environmental Data Service: Asheville, 1971. _____. Climatological Data Virginia: October 1971. Environmental Data Service: Asheville, 1971.

Vojtech, Pat. Lighting the Bay: Tales of Chesapeake Lighthouses. Tidewater Publishers: Centreville, 1996.

Washington Post Company. "Heavy Rain in Lynchburg" Washington Post 23 June 1886: 1. _____. "Great Floods in Virginia" Washington Post 3 July 1886: 1. _____. "A Cyclone Off Cape Henry" Washington Post 23 August 1887: 1. _____. "Ruin of Wind and Rain" Washington Post 22 August 1888: 1. _____. "The Edge of a Tornado" Washington Post 22 August 1888: 2. _____. "In the Storm's Pathway" Washington Post 23 August 1888: 1. _____. "Death at a Colored Baptizing" Washington Post 24 August 1888: 2. _____. "Drouth Followed by Flood" Washington Post 12 September 1888: 2. _____. "British Schooner Wrecked" Washington Post 13 September 1888: 2. _____. "The First Winter Storm" Washington Post 26 November 1888: 1. _____. "Out of Death's Jaws" Washington Post 27 November 1888: 1. _____. "A Strange April Day" Washington Post 7 April 1889: 2. _____. "Wind, Water and Fire" Washington Post 8 April 1889: 1. _____. "A Storm's Fury" Washington Post 12 September 1889: 1. _____. "Wrecks on the Seashore" Washington Post 13 September 1889: 1. _____. Washington Post 14 September 1889: 1. _____. "Caught in a Storm" Washington Post 25 September 1889: 1. _____. "Will Be a Total Loss" Washington Post 11 October 1891: 1. _____. "Struck By a Storm" Washington Post 29 August 1893: 1. _____. "Scores Were Lost" Washington Post 30 August 1893: 1-2.

Appendix D
Hazard Ranking Sheets

Hampton - Priority of Hazards

Methodology

Hazards were identified and prioritized through an exercise that was conducted with the City of Hampton, VA . In the exercise participants were asked to identify natural hazards that occur in the City of Hampton and rank the selected hazards from highest to lowest priority. The results of those exercises are included in the table below titled "Prioritization of Hazards for the City of Hampton." The priority hazards were determined using a combination of historical occurrences, public perception of hazard risk, and the probability of future occurrence based on other technical resources.

Hazard	**Probability of Occurrence**	[1]**Public Perception of Occurrence**	**Historical Occurrence**	**References**
NATURAL HAZARDS				
Winter Weather	L	M		HMPC, FEMA, NCDC
Thunderstorm / Lightning	M-H	M-H		HMPC, NOAA-NCDC
Wind	M	H		HMPC, NOAA-NCDC
Hurricanes	M	H[2]		HMPC
Tornadoes	L	L		HMPC
Drought	L	M		HMPC
Earthquakes	N	L		HMPC, USGS
Landslides	N	N		HMPC
Sea Level Rise	L	L		HMPC
Wildfires	L	L		HMPC
Biological Hazards	L	L		HMPC
Floods - Riverine3	M	H		HMPC, FEMA, NCDC
Floods - Coastal	M	H		HMPC, FEMA, NCDC
H=High; M=Moderate; L=Low; N=No; N/A=Not Applicable, Unknown=Historical Data Unavailable; OEM=City of Newport News Office of Emergency Management; NCDC=National Climatic Data Center; FEMA=Federal Emergency Management Agency; USGA=United States Geological Survey; MHA=Multi-Hazard Atlas				

[1] Back up with a survey using the “ Household Natural Hazards Preparedness Questionnaire “
[2] Post Floyd and Isabel
[3] Flash Floods

Newport News - Priority of Hazards

Methodology

Hazards were identified and prioritized through an exercise that was conducted with the City of Newport News, VA . In the exercise participants were asked to identify natural hazards that occur in the City of Newport News and rank the selected hazards from highest to lowest priority. The results of those exercises are included in the table below titled "Prioritization of Hazards for the City of Newport News." The priority hazards were determined using a combination of historical occurrences, public perception of hazard risk, and the probability of future occurrence based on other technical resources.

Hazard	Probability of Occurrence	Public Perception of Occurrence	Historical Occurrence	References
NATURAL HAZARDS				
Winter Weather	M	M	M	HMPC.FEMA, NCDC
Thunderstorm / Lightning	L	L	L	HMPC,NOAA-NCDC
Wind	M	H	M	HMPC,NOAA-NCDC
Hurricanes	L	M	L	HMPC
Tornadoes	L	L	L	HMPC
Drought	L	L	L	HMPC
Earthquakes	L	L	L/NO	USGS
Landslides	L	L	NO	HMPC
Sea Level Rise	L	L	L	HMPC
Wildfires	L	L	L	HMPC
Biological Hazards	L	M	L	HMPC
Floods - Riverine	M/H	H	M/H	HMPC, FEMA, NCDC
Floods - Coastal	H	H	H	HMPC, FEMA, NCDC
Dam Failures	L	L	NO	HMPC
H=High; M=Moderate; L=Low; N=No; N/A=Not Applicable, Unknown=Historical Data Unavailable; HMPC = Newport News Hazard Mitigation Planning Committee; OEM=City of Newport News Office of Emergency Management; NCDC=National Climatic Data Center; FEMA=Federal Emergency Management Agency; USGA=United States Geological Survey; MHA=Multi-Hazard Atlas				

Williamsburg - Priority of Hazards

Methodology

Hazards were identified and prioritized through an exercise that was conducted with the City of Williamsburg, VA . In the exercise participants were asked to identify natural hazards that occur in the City of Williamsburg and rank the selected hazards from highest to lowest priority. The results of those exercises are included in the table below titled "Prioritization of Hazards for the City of Williamsburg." The priority hazards were determined using a combination of historical occurrences, public perception of hazard risk, and the probability of future occurrence based on other technical resources.

Hazard	Probability of Occurrence	Public Perception of Occurrence	Historical Occurrence	References
NATURAL HAZARDS				
Winter Weather	M	M	M	HMPC, FEMA, NCDC
Thunderstorm / Lightning	H	H	H	HMPC, NOAA-NCDC
Wind	L	L	L	HMPC, NOAA-NCDC
Hurricanes	L	L	L	HMPC
Tornadoes	L	L	L	HMPC
Drought	L	L	L	HMPC
Earthquakes	L	L	L	HMPC, USGS
Landslides	L	L	L	HMPC
Sea Level Rise	L	L	L	HMPC
Wildfires	L	L	L	HMPC
Biological Hazards	L	L	L	HMPC
Floods - Riverine	M	L	M	HMPC, FEMA, NCDC
Floods - Coastal	L	L	L	HMPC, FEMA, NCDC
Dam Failures	L	L	L	
H=High; M=Moderate; L=Low; N=No; N/A=Not Applicable, Unknown=Historical Data Unavailable; HMPC= Williamsburg Hazard Mitigation Planning Committee; OEM=City of Williamsburg Office of Emergency Management; NCDC=National Climatic Data Center; FEMA=Federal Emergency Management Agency; USGA=United States Geological Survey; MHA=Multi-Hazard Atlas				

James City County - Priority of Hazards

Methodology

Hazards were identified and prioritized through an exercise that was conducted with James City County, VA. In the exercise participants were asked to identify natural hazards that occur in James City County and rank the selected hazards from highest to lowest priority. The results of those exercises are included in the table below titled "Prioritization of Hazards for James City County." The priority hazards were determined using a combination of historical occurrences, public perception of hazard risk, and the probability of future occurrence based on other technical resources.

Hazard	Probability of Occurrence	Public Perception of Occurrence	Historical Occurrence	References
NATURAL HAZARDS				
Winter Weather	H			HMPC, FEMA, NCDC
Thunderstorm / Lightning	H			HMPC, NOAA-NCDC
Wind	H			HMPC, NOAA-NCDC
Hurricanes	H			HMPC
Tornadoes	H			HMPC
Drought	H			HMPC
Earthquakes	L			HMPC, USGS
Landslides	L			
Sea Level Rise	L			HMPC
Wildfires	L			HMPC
Biological Hazards	L			
Floods - Riverine	L			HMPC, FEMA, NCDC
Floods - Coastal	L			HMPC, FEMA, NCDC
Dam Failures				
H=High; M=Moderate; L=Low; N=No; N/A=Not Applicable, Unknown=Historical Data Unavailable; HMPC = James City Hazard Mitigation Planning Committee; OEM=James City County Office of Emergency Management; NCDC=National Climatic Data Center; FEMA=Federal Emergency Management Agency; USGA=United States Geological Survey;				

York County - Priority of Hazards

Methodology

Hazards were identified and prioritized through an exercise that was conducted with York County, VA . In the exercise participants were asked to identify natural hazards that occur in York County and rank the selected hazards from highest to lowest priority. The results of those exercises are included in the table below titled "Prioritization of Hazards for York County." The priority hazards were determined using a combination of historical occurrences, public perception of hazard risk, and the probability of future occurrence based on other technical resources.

Hazard	**Probability of Occurrence**	**Public Perception of Occurrence**	**Historical Occurrence**	**References**
NATURAL HAZARDS				
Winter Weather	L	M	1998	HMPC, FEMA, NCDC/NWS/Newspaper
Thunderstorm / Lightning	H	H		HMPC, NOAA-NCDC/Newspaper
Wind	M	L	1990-2003	HMPC, NOAA-NCDC/NWS
Hurricanes	M	M	1999-2003	HMPC, NWS/Newspaper
Tornadoes	L	L	2003	HMPC, NWS/Newspaper
Drought	L	L	2002	HMPC, NWS/Newspaper
Earthquakes	L	L	1995	HMPC, USGS/Newspaper
Landslides	L	L	N/A	NONE
Sea Level Rise	H	L		HMPC, VIMS/Website
Wildfires	M	L		Fire Marshal/Park Service
Biological Hazards	M	H		Mosquito Control
Floods - Riverine	L	L		HMPC, FEMA, NCDC
Floods - Coastal	M/H	M		HMPC, FEMA, NCDC
Dam Failures	L	L		
H=High; M=Moderate; L=Low; N=No; N/A=Not Applicable, Unknown=Historical Data Unavailable; OEM=York County Office of Emergency Management; HMPC = York County Hazard Mitigation Planning Committee; NCDC=National Climatic Data Center; FEMA=Federal Emergency Management Agency; USGA=United States Geological Survey; MHA=Multi-Hazard Atlas				

Appendix E
Critical Facilities Inventory

Critical Facilities Inventory

The following coding was used for identification of critical facilities on the large format Multi-Hazard Mapping in Appendix F.

School	SC
Police	PO
Hospital	HO
Fire	FR
Airport	AI
Nursing Home	NH
Trailer Park	TP
Emergency Operations Center	EC
Day Care	DC
Clinics	CL
Pump Stations	PS
Communications	CO
E-911	E9
Government	GO
Sub Station	SB

Table E-1: City of Hampton Critical Facilities		
Name	**Code**	**Number**
Station 6	FR	2
Station 9	FR	3
Station 10	FR	4
Station 8	FR	5
Station 7	FR	6
Station 2	FR	7
Station 3	FR	8
Station 1	FR	9
Station 5	FR	10
Station 4	FR	11
Fire Administration (City Hall)	FR	12
Fire Training Center	FR	13
Sentara Careplex	HO	3
Veterans Administration Center	HO	4
Dolittle	PO	2
Merrimac	PO	3
Police Headquarters	PO	4
LaSalle	PO	5
Police Field Office	PO	6
Coliseum Central	PO	7
Kecoughtan Court	PO	8
Briarfield	PO	9
Police	PO	54
Emmanuel Lutheran School	SC	5
Hampton Roads Convention Center/Hampton Coliseum	GO	1
Francis Asbury Elementary School	SC	8
Samuel P Langley Elementary School	SC	30
Machen Elementary School	SC	18
Thomas Nelson Community College	SC	36

Table E-1: City of Hampton Critical Facilities		
Name	**Code**	**Number**
New Horizon Regional Education Center	SC	23
Phillips Elementary School	SC	27
Willow Oaks Learning Foundation	SC	39
Booker Elementary School	SC	41
Gloria Dei Lutheran School	SC	9
Kecoughtan High School	SC	15
Syms Middle School	SC	34
Burbank Elementary School	SC	42
Hampton Christian Schools Inc	SC	10
Merrimack Elementary School	SC	21
Cooper Elementary School	SC	1
Bethel High School	SC	43
Kraft Elementary School	SC	16
Tyler Elementary School	SC	38
Eaton Middle School	SC	3
Barron Elementary School	SC	44
Cary Elementary School	SC	45
Jones Middle School	SC	14
Smith Elementary School	SC	31
Calvary Christian Academy	SC	47
Fox Hill Private School	SC	7
Davis Middle School	SC	2
North Hampton Early Learning Child Center	SC	25
Spratley Middle School	SC	32
Peninsula Primary School	SC	26
Forrest Elementary School	SC	6
Mary Peake – Y.H. Thomas Center	SC	20
Phoebus High School	SC	28
Aberdeen Elementary School	SC	48
Tucker Capps Elementary School	SC	37
Calvary Covenant School	SC	49
Jane Bryan Elementary School	SC	13
Moton Elementary School	SC	22
Mallory Elementary School	SC	19
Hampton High School	SC	11
Hampton University	SC	12
Tarrant Elementary School	SC	35
Bethel Christian School	SC	50
Robert E Lee Elementary School	SC	29
New Mount Olive Christian Academy	SC	24
Lindsay Middle School	SC	17
Bassette Elementary School	SC	51
St Mary Star Of The Sea School	SC	33
Armstrong Elementary School	SC	52
Emmanuel Grace Baptist Church	SC	4
Bradford Hall	SC	53
Wythe Elementary School	SC	40

Table E-2 City of Newport News Critical Facilities		
Name	**Code**	**Number**
Mary Immaculate	CL	2
Sentara Urgent Care	CL	3
Public Health Center	CL	4
Peninsula Medical Center	CL	7
Dr Cecil F Evans Office	CL	8
Doctor's Office	CL	9
Now Care Medical Center	CL	10
East End Health Center	CL	11
Whittaker Hosp Medical Office	CL	12
Stephen's Child Care	DC	2
Child Care	DC	3
Early Start Learning Center	DC	4
The Garden Of Children Ltd	DC	5
Holloman Child Care Center	DC	6
Teddy Bear	DC	7
Bright Horizons	DC	8
Children's World Inc	DC	9
Riverside Employee Child Care	DC	10
Unique Child Care	DC	11
Lollipop Lane	DC	12
Hampton Roads Montessori School	DC	13
Kinder Care	DC	14
While Away School	DC	15
While Away School	DC	16
United Child Care	DC	17
Bellwood Tender Care	DC	18
Warwick Kids Academy	DC	19
Youth Campus Day Care	DC	20
Ding Dong Kindergarden	DC	21
Tic-Toc Kindergarten	DC	22
Quality Nursery & Garden Center	DC	23
Jimmy's Nursery	DC	24
Emergency Operations Center	EC	2
Emergency Operations Center	EC	3
Station 5	FR	2
Fire Warehouse	FR	3
Station 9	FR	4
Station 4	FR	5
Station 6	FR	6
Station 3	FR	7
Station 8	FR	8
Station 10	FR	9
Station 2	FR	10
Station 7	FR	11
Station 1	FR	12
Fort Eustis Station	FR	13
Fort Eustis Station	FR	14
Fire Training Center	FR	15
Riverside Medical Center	HO	2
Mary Immaculate Hospital	HO	3
McDonald Army Hospital	HO	4
Woodside Hospital	HO	6
Serenity Inc	NH	2
Zion Baptist Convalescent	NH	3
Hilton Plaza Adult Home	NH	4
St Francis Nursing Center	NH	5
Newport News Nursing Center	NH	6
Newport Convalescent Center	NH	7
James River Convalescent Center	NH	8
James River Convalescent Center	NH	9

Table E-2 City of Newport News Critical Facilities		
Name	**Code**	**Number**
Because We Care Home for Adults	NH	10
Huntington Nursing Home	NH	11
Nursing Home	NH	12
Mdn Center	NH	13
Mennowood Retirement Community	NH	14
Spratley Housing	NH	15
Pump Station	PS	098
Pump Station	PS	099
Pump Station	PS	101
Pump Station	PS	102
Pump Station	PS	088
Pump Station	PS	089
Pump Station	PS	090
Pump Station	PS	091
Pump Station	PS	112
Pump Station	PS	
Pump Station	PS	
Pump Station	PS	115
Pump Station	PS	116
Pump Station	PS	117
Pump Station	PS	084
Pump Station	PS	085
Pump Station	PS	086
Pump Station	PS	087
Pump Station	PS	095
Pump Station	PS	096
Pump Station	PS	097
Pump Station	PS	118
Pump Station	PS	119
Pump Station	PS	120
Pump Station	PS	121
Pump Station	PS	122
Pump Station	PS	123
Pump Station	PS	124
Pump Station	PS	125
Pump Station	PS	126
Pump Station	PS	127
Pump Station	PS	
Pump Station	PS	129
Pump Station	PS	130
Pump Station	PS	131
Pump Station	PS	132
Pump Station	PS	133
Pump Station	PS	134
Pump Station	PS	135
Pump Station	PS	136
Pump Station	PS	137
Pump Station	PS	138
Pump Station	PS	139
Pump Station	PS	140
Pump Station	PS	141
Pump Station	PS	142
Pump Station	PS	143
Pump Station	PS	144
Pump Station	PS	145
Pump Station	PS	146
Pump Station	PS	147
Pump Station	PS	093
Pump Station	PS	094
Pump Station	PS	
Pump Station	PS	
Pump Station	PS	

Table E-2 City of Newport News Critical Facilities		
Name	**Code**	**Number**
Pump Station	PS	092
Pump Station	PS	
Pump Station	PS	108
Pump Station	PS	
Pump Station	PS	110
Pump Station	PS	
Pump Station	PS	
Pump Station	PS	148
Pump Station	PS	149
Pump Station	PS	150
Pump Station	PS	158
Pump Station	PS	159
Pump Station	PS	160
Pump Station	PS	161
Pump Station	PS	
Pump Station	PS	163
Pump Station	PS	164
Pump Station	PS	
Pump Station	PS	152
Pump Station	PS	153
Pump Station	PS	154
Pump Station	PS	155
Pump Station	PS	156
Pump Station	PS	171
Pump Station	PS	172
Pump Station	PS	173
Pump Station	PS	174
Pump Station	PS	182
Pump Station	PS	183
Pump Station	PS	184
Pump Station	PS	157
Pump Station	PS	165
Pump Station	PS	166
Pump Station	PS	167
Pump Station	PS	168
Pump Station	PS	169
Pump Station	PS	170
Pump Station	PS	185
Pump Station	PS	186
Pump Station	PS	187
Pump Station	PS	054
Pump Station	PS	055
Pump Station	PS	056
Pump Station	PS	057
Pump Station	PS	058
Pump Station	PS	059
Pump Station	PS	060
Pump Station	PS	061
Pump Station	PS	062
Pump Station	PS	063
Pump Station	PS	064
Pump Station	PS	065
Pump Station	PS	066
Pump Station	PS	067
Pump Station	PS	068
Pump Station	PS	069
Pump Station	PS	070
Pump Station	PS	071
Pump Station	PS	072
Pump Station	PS	073
Pump Station	PS	074
Pump Station	PS	075

Table E-2 City of Newport News Critical Facilities		
Name	**Code**	**Number**
Pump Station	PS	076
Pump Station	PS	077
Pump Station	PS	078
Pump Station	PS	079
Pump Station	PS	080
Pump Station	PS	081
Pump Station	PS	082
Pump Station	PS	188
Pump Station	PS	175
Pump Station	PS	083
Pump Station	PS	176
Pump Station	PS	177
Pump Station	PS	178
Pump Station	PS	179
Pump Station	PS	180
Pump Station	PS	181
Pump Station	PS	189
Pump Station	PS	190
Pump Station	PS	191
Pump Station	PS	192
Pump Station	PS	193
Pump Station	PS	194
Pump Station	PS	195
Pump Station	PS	196
Pump Station	PS	197
Pump Station	PS	198
Pump Station	PS	199
Pump Station	PS	200
Pump Station	PS	001
Pump Station	PS	002
Pump Station	PS	003
Pump Station	PS	004
Pump Station	PS	005
Pump Station	PS	006
Pump Station	PS	007
Pump Station	PS	008
Pump Station	PS	009
Pump Station	PS	011
Pump Station	PS	012
Pump Station	PS	013
Pump Station	PS	013
Pump Station	PS	014
Pump Station	PS	015
Pump Station	PS	015
Pump Station	PS	017
Pump Station	PS	018
Pump Station	PS	019
Pump Station	PS	020
Pump Station	PS	021
Pump Station	PS	022
Pump Station	PS	023
Pump Station	PS	024
Pump Station	PS	025
Pump Station	PS	026
Pump Station	PS	027
Pump Station	PS	028
Pump Station	PS	029
Pump Station	PS	030
Pump Station	PS	031
Pump Station	PS	032
Pump Station	PS	033
Pump Station	PS	034

Table E-2 City of Newport News Critical Facilities		
Name	**Code**	**Number**
Pump Station	PS	035
Pump Station	PS	036
Pump Station	PS	037
Pump Station	PS	038
Pump Station	PS	039
Pump Station	PS	040
Pump Station	PS	042
Pump Station	PS	043
Pump Station	PS	044
Pump Station	PS	045
Pump Station	PS	046
Pump Station	PS	047
Pump Station	PS	048
Pump Station	PS	049
Pump Station	PS	050
Pump Station	PS	051
Pump Station	PS	052
Pump Station	PS	053
Pump Station	PS	WWPFS
Pump Station	PS	WWPBO
Pump Station	PS	WWPAP
Pump Station	PS	WWPAJ
Pump Station	PS	WWPDV

Table E-3: City of Williamsburg Critical Facilities		
Name	**Code**	**Number**
City Municipal Building	GO	501
911 Center	E9	502
Fire & EMS Department	FR	503
Police Department	PO	504
Emergency Operations Center	EC	505
Fire Administration	FR	506
Williamsburg/James City County Courthouse	GO	507
Sentara Williamsburg Community Hospital	HO	508
Williamsburg Center Genesis Elder Care	NH	509
Micand Retirement Center	NH	510
Blayton Building Elderly Housing	AP	511
Matthew Whaley Elementary School & City Shelter	SC	512
James Blair Middle School	SC	513
Berkeley Middle School	SC	514
Walsingham Academy Upper School	SC	515
Walsingham Academy Lower School	SC	516
Communications Towers	CO	517
Power Sub Station	SB	544
Power Sub Station	SB	545
Power Sub Station	SB	546
Communication Tower	CO	547
Pump Station	PS	522
Pump Station	PS	523
Pump Station	PS	524
Pump Station	PS	525
Pump Station	PS	526
Pump Station	PS	527
Pump Station	PS	528
Pump Station	PS	529
Pump Station	PS	530
Pump Station	PS	531
Pump Station	PS	533
Pump Station	PS	534
Pump Station	PS	535
Pump Station	PS	536
Pump Station	PS	532

Table E-4: James City County Critical Facilities		
Name	**Code**	**Number**
Williamsburg Airport	AI	1
Emergency Operations Center	EC	1
Fire Station 2	FR	2
Fire Station 5	FR	3
Fire Station 3	FR	5
Fire Station 1	FR	1
Dispatch Center	FR	4
Law Enforcement Center	PO	1
Toano School	SC	14
Noney School	SC	15
Stonehouse Elementary School	SC	16
James Blair Middle School	SC	2
Berkeley Middle School	SC	3
Lafayette High School	SC	4
Jamestown High School	SC	5
D.J. Montague Elementary School	SC	7
Clara Byrd Baker Elementary School	SC	8
Rawls Byrd Elementary School	SC	9
Matthew Whaley Elementary School	SC	12
James River Elementary School	SC	13

Table E-5: York County Critical Facilities		
Name	**Code**	**Number**
Fire Station # 2	FR	53
Seaford Station Number 6	FR	62
Bruton Station Number 3	FR	65
Grafton Station Number 1	FR	114
Yorktown Station Number 4	FR	122
Tabb Station Number 2	FR	134
Skimino Station Number 5	FR	135
Yorktown Library	LB	221
Tabb Library	LB	222
Public Safety Building	GO	223
Solid Waste Management Center	GO	224
Environmental Services Building	GO	225
York/Poquoson Courthouse	GO	226
Finance Building	GO	227
Griffin-Yeates Center	GO	228
General Services	GO	229
Geo. Wash. Inn	PS	149
Bruton High Sch.	PS	150
Pinetree Road	PS	151
Royal Grant	PS	152
Hickory Hills	PS	153
Queenswood	PS	154
Penniman East	PS	155
Pierpoint Place	PS	156
Cedar Valley/Wal Mart	PS	157
Read Street	PS	158
Winders Pond	PS	159
Hornsbyville Road	PS	160
Cockletown Road	PS	161
Kings Villa	PS	162
Sommerville	PS	163
Oriana Road	PS	164
Landfill	PS	165
Hollywood	PS	166
Moss Avenue	PS	167
Ft. Eustis Boulevard	PS	168
Barcroft	PS	169
Route 17	PS	170
Don Juan	PS	171
Grafton Woods	PS	172
Pinehurst Vac	PS	173
Brandywine	PS	174
Mill Cove	PS	175
Scotch Toms	PS	176
Goosley Road	PS	177
Lodge Road	PS	178
York High	PS	179
Kiln Creek 1	PS	180
Kiln Creek 2	PS	181
Olde Port Cove	PS	182
Running Man 1	PS	183
Whispering Winds	PS	184
Marlbank Cove	PS	185
Lackey	PS	186
Yorkshire Downs	PS	187
Coventry	PS	188
Running Man 2	PS	189
Tabb Lakes	PS	190
York Co.Central	PS	191
Baptist Road	PS	192
Coburn Court	PS	193

Table E-5: York County Critical Facilities		
Name	**Code**	**Number**
Carys Chapel Rd.	PS	194
Lakes Of Dare	PS	195
Crestwoods	PS	196
Tidemill	PS	197
Seaford Vac. Sta	PS	198
Dandy Vac Sta.	PS	199
Cary's Chapel 2	PS	200
Calthop Neck Vac	PS	201
Belmount Apts	PS	202
Williamsburg Hosp.	PS	203
Schooner Blvd	PS	204
Corvette	PS	205
Jonadab Rd.	PS	206
Lindsay Landing	PS	207
Overlook Point	PS	208
Road Water Sta.	PS	209
Banbury Water	PS	210
Rochambeau Sta	PS	211
Lightfoot Sta.	PS	212
Dare Vacuum Sta.	PS	213
Yorktown Road	PS	214
Dare Heights	PS	215
Water Street	PS	216
Queenslake	PS	217
Kings Creek	PS	218
Coast Guard	PS	219
Colony Pines	PS	220
Tabb Middle School	SC	55
Mount Vernon Elementary School	SC	56
Grafton High/Middle School	SC	58
Yorktown Elementary School	SC	61
Yorktown Middle School	SC	63
Magruder Elementary School	SC	64
Bruton High School	SC	66
Coventry Elementary School	SC	77
Tabb High School	SC	80
York High School	SC	81
Tabb Elementary School	SC	83
Dare Elementary School	SC	131
Grafton Bethel Elementary School	SC	133
Waller Mill Elementary School	SC	136
Queens Lake Middle School	SC	137

Appendix F
Multi-Hazard Mapping
Large-Format Maps

Appendix G
Alternative Multi-Hazard Mitigation Actions

Alternative Multi-Hazard Mitigation Actions

PREVENTION: Preventive measures are designed to keep the problem from occurring or getting worse. Their objective is to ensure that future development is not exposed to damage and does not increase damage to other properties.

- ***Planning***
- ***Zoning***
- ***Open Space Preservation***
- ***Land Development Regulations***
  - ***Subdivision regulations***
  - ***Building Codes***
    - ***Fire-Wise Construction***
  - ***Floodplain development regulations***
  - ***Geologic Hazard Areas development regulations (for roads too!)***
- ***Storm Water Management***
- ***Fuels Management, Fire-Breaks***

EMERGENCY SERVICES measures protect people during and after a disaster. A good emergency services program addresses all hazards. Measures include:

- ***Warning*** (flooding, tornadoes, winter storms, fire)
  - NOAA Weather/All-Hazards Radio
  - Sirens
  - "Reverse 911" (Emergency Notification System)
- ***Emergency Response***
  - ***Evacuation & Sheltering***
  - ***Communications***
  - ***Emergency Planning***
    - Activating the EOC (emergency management)
    - Closing/Reversing streets/bridges (police or public works)
    - Shutting off power to threatened areas (utility company)
    - Holding/releasing children at school (school district)
    - Passing out sand and sandbags (public works)
    - Ordering an evacuation (mayor)
    - Opening emergency shelters (Red Cross)
    - Monitoring water levels (engineering)
    - Security and other protection measures (police)
- ***Critical Facilities Protection (Buildings or locations vital to the response and recovery effort, such as police/fire stations, hospitals, sewage treatment plants/lift stations, power substations)***
  - Buildings or locations that, if damaged, would create secondary disasters, such as hazardous materials facilities and nursing homes
  - Lifeline Utilities Protection
- ***Post-Disaster Mitigation***
  - Building Inspections
  - ID mitigation opportunities & funding before reconstruction

PROPERTY PROTECTION: Property protection measures are used to modify buildings subject to damage rather than to keep the hazard away. A community may find these to be inexpensive measures because often they are implemented by or cost-shared with property owners. Many of the measures do not affect the appearance or use of a building, which makes them particularly appropriate for historical sites and landmarks.

- ***Retrofitting/disaster proofing***
  - ***Floods***
    - Wet/Dry floodproofing (barriers, shields, backflow valves)
    - Relocation/Elevation
    - Acquisition
    - Retrofitting
  - ***High Winds/Tornadoes***
    - Safe Rooms
    - Securing roofs and foundations with fasteners and tie-downs
    - Strengthening garage doors and other large openings
  - ***Winter Storms***
    - Immediate snow/ice removal from roofs, tree limbs
    - “Living” snow fences
  - ***Geologic Hazards (Landslides, earthquakes, sinkholes)***
    - Anchoring, bracing, shear walls
    - Dewatering sites, agricultural practices
    - Catch basins
  - ***Drought***
    - Improve water supply (transport/storage/conservation)
    - Remove moisture competitive plants (Tamarisk/Salt Cedar)
    - Water Restrictions/Water Saver Sprinklers/Appliances
    - Grazing on CRP lands (no overgrazing-see Noxious Weeds)
    - Create incentives to consolidate/connect water services
    - Recycled wastewater on golf courses
  - ***Wildfire, Grassfires***
    - Replacing building components with fireproof materials
      - Roofing, screening
    - Create “Defensible Space”
    - Installing spark arrestors
    - Fuels Modification
  - ***Noxious Weeds/Insects***
    - Mowing
    - Spraying
    - Replacement planting
    - Stop overgrazing
    - Introduce natural predators

- ***Insurance***

NATURAL RESOURCE PROTECTION: Natural resource protection activities are generally aimed at preserving (or in some cases restoring) natural areas. In so doing, these activities enable the naturally beneficial functions of floodplains and watersheds to be better realized. These natural and beneficial floodplain functions include the following:

- storage of floodwaters
- absorption of flood energy
- reduction in flood scour
- infiltration that absorbs overland flood flow
- groundwater recharge
- removal/filtering of excess nutrients, pollutants, and sediments from floodwaters
- habitat for flora and fauna
- recreational and aesthetic opportunities

Methods of protecting natural resources include:

- ***Wetlands Protection***
- ***Riparian Area/Habitat Protection/Threatened-Endangered Species***
- ***Erosion & Sediment Control/Dune Protection***
- ***Best Management Practices***

  Best management practices ("BMPs") are measures that reduce nonpoint source pollutants that enter the waterways. Nonpoint source pollutants come from non-specific locations. Examples of nonpoint source pollutants are lawn fertilizers, pesticides, and other farm chemicals, animal wastes, oils from street surfaces and industrial areas and sediment from agriculture, construction, mining and forestry. These pollutants are washed off the ground's surface by stormwater and flushed into receiving storm sewers, ditches and streams. BMPs can be implemented during construction and as part of a project's design to permanently address nonpoint source pollutants. There are three general categories of BMPs:

  1. Avoidance: setting construction projects back from the stream.
  2. Reduction: Preventing runoff that conveys sediment and other water-borne pollutants, such as planting proper vegetation and conservation tillage.
  3. Cleanse: Stopping pollutants after they are en route to a stream, such as using grass drainageways that filter the water and retention and detention basins that let pollutants settle to the bottom before they are drained

- ***Dumping Regulations***
- ***Set-back regulations/buffers***
- ***Fuels Management***
- ***Water Use Restrictions***
- ***Landscape Management/Dune Management***
- ***Weather Modification***

STRUCTURAL PROJECTS have traditionally been used by communities to control flows and water surface elevations. Structural projects keep flood waters away from an area. They are usually designed by engineers and managed or maintained by public works staff. These measures are popular with many because they "stop" flooding problems. However, structural projects have several important shortcomings that need to be kept in mind when considering them for flood hazard mitigation:

- They are expensive, sometimes requiring capital bond issues and/or cost sharing with Federal agencies, such as the U.S. Army Corps of Engineers or the Natural Resources Conservation Service.

- They disturb the land and disrupt natural water flows, often destroying habitats.

- They are built to a certain flood protection level that can be exceeded by a larger flood, causing extensive damage.

- They can create a false sense of security when people protected by a structure believe that no flood can ever reach them.

- They require regular maintenance to ensure that they continue to provide their design protection level.

Structural measures include:

- ***Detention/Retention structures***
- ***Erosion and Sediment Control***
- ***Basins/Low-head Weirs***
- ***Channel Modifications***
- ***Culvert resizing/replacement/Maintenance***
- ***Levees and Floodwalls***
- ***Anchoring, grading, debris basins (for landslides)***
- ***Fencing (for snow, sand, wind)***
- ***Drainage System Maintenance***
- ***Reservoirs(for flood control, water storage, recreation, agriculture)***
- ***Diversions***
- ***Storm Sewers***

PUBLIC INFORMATION: A successful hazard mitigation program involves both the public and private sectors. Public information activities advise property owners, renters, businesses, and local officials about hazards and ways to protect people and property from these hazards. These activities can motivate people to take protection

- ***Hazard Maps and Data***
- ***Outreach Projects*** (mailings, media, web, speakers bureau, displays)
- ***Library Resources***
- ***Real Estate Disclosure***
- ***Environmental Education***

Technical Assistance **Health & Safety Maintenance (clean-up per hazard)**

Appendix H
Criteria for Selecting Mitigation Measures

Criteria for Selecting Mitigation Measures

1. STAPLE

Social: Does the measure treat people fairly? (different groups, different generations)

Technical: Will it work? (Does it solve the problem? Is it feasible?)

Administrative: Do you have the capacity to implement & manage project?

Political: Who are the stakeholders? Did they get to participate? Is there public s support? Is political leadership willing to support?

Legal: Does your organization have the authority to implement? Is it legal? Are there liability implications?

Economic: Is it cost-beneficial? Is there funding? Does it contribute to the local economy or economic development?

Environmental: Does it comply with Environmental regulations?

2. **SUSTAINABLE DISASTER RECOVERY**

Quality of Life

Social Equity

Hazard Mitigation

Economic Development

Environmental Protection/Enhancement

Community Participation

3. SMART GROWTH PRINCIPLES

Infill versus Sprawl

Efficient Use of Land Resources

Full Use of Urban Resources

Mixed Uses of Land

Transportation Options

Detailed, Human-Scale Design

4. OTHER

Does measure address area with highest risk?

Does measure protect …

- The largest # of people exposed to risk?
- The largest # of buildings?
- The largest # of jobs?
- The largest tax income?
- The largest average annual loss potential?
- The area impacted most frequently?
- Critical Infrastructure (access, power, water, gas, telecommunications)

Timing of Available funding

Visibility of Project

Community Credibility

Appendix I
Public Meeting Notices and Community Resolutions of Adoption

From the *Daily Press*, 2/13/05

MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

Hampton, Newport News, Williamsburg, James City County, York County

The purpose is to solicit input from the public in the development of this plan. These jurisdictions are developing a draft Natural Hazard Mitigation Plan in order both to reduce the impact of future disasters and also meet Federal Requirements.

Jurisdiction Planning Groups and AMEC Earth and Environmental will be at the following locations to discuss the planning process and receive public input:

February 16, 2005, 7:00 P.M. - 8:00 P.M.
101 F Mounts Bay Building F, James City County

February 17, 2005 7:00 P.M. - 8:00 P.M.
York Hall, East Room, Yorktown, York County

February 28, 2005 7:00 P.M. - 8:00 P.M.
Sandy Bottom Nature Park, 1255 Big Bethel Rd, Hampton

Citizens from participating jurisdictions can attend any of the three meetings listed. For further information please contact your local Emergency Management Office or Planning Department.

PUBLIC MEETINGS FOR NATURAL HAZARD MITIGATION PLAN

The Peninsula Hazard Mitigation Planning Committee, comprising of the City of Newport News, City of Hampton, City of Williamsburg, York County and James City County are sponsoring the development of **a regional comprehensive natural hazard mitigation plan** to better marshal County and Community resources in **addressing potential hazards before they occur**, and, to **maintain eligibility for mitigation funding from the Federal Emergency Management Agency** (FEMA). Within the County and the City, **this plan will help lower the cost of flood insurance.**

We'd like **YOUR feedback** regarding this important document, which must be approved by each City Council, the County Board of Supervisors, the State and FEMA this fall.

The plan is being developed by a Hazard Mitigation Planning Committee (HMPC) with input from County and City agencies, including each incorporated community, Special Districts (e.g., reclamation, recreation, fire, community college), regional flood and state and federal agencies (e.g., FEMA, USACE, NWS).

Before the recommendations and the first draft plan are developed, the HMPC would like to present our research and findings regarding the natural hazards posing threats to the Peninsula Area, and our current ability to counter those threats. Your comments and ideas are invited and are welcome at the upcoming public meetings, scheduled as follows:

Wednesday, February 16, 2005
James City County Government Complex
Board Room
101-F Mounts Bay Road
Williamsburg, VA 23185
7:00 p.m. - 8:30 p.m.

The program will include time for comments, questions and answers after a summary of each planning step is explained.

The deadline for public comment will be following the third phase this spring when the draft plan will be ready for review. Your feedback will be incorporated into the final version of the plan which will then reviewed by the Virginia Department of Emergency Management and FEMA, Region III. Upon approval, the plan will be presented to the County Board of Supervisors, and each incorporated community.

From the *Daily Press*, 6/19/05

MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

Hampton, Newport News, Williamsburg, James City County, York County

The purpose if to solicit input from the public in the development of this plan. These jurisdictions are developing a draft Natural Hazard Mitigation Plan in order both to reduce the impact of future disasters and also meet Federal Requirements.

Jurisdiction Planning Groups and AMEC Earth and Environmental will be at the following locations to discuss the planning processing and receive public input:

June 22, 2005 6:30 pm-7:30 pm

Pearl Bailey Library 2510 Wickham Avenue, Newport News

June 23, 2005 7:00 pm-8:00 pm

Kenny Wallace Neighborhood Resource Center 2315 Victoria Blvd, Hampton

June 27, 2005 7:00 pm-8:00 pm

Governement Center Building F 101 Mounts Bay Road, James City County

Citizens from participating jurisdictions can attend any of the three meetings listed. For further information please contact your local Emergency Management Office or Planning Department.

From the *Daily Press*, 10/30/05

MULTI-JURISDICTIONAL
HAZARD MITIGATION PLAN

Hampton, Newport News, Williamsburg, James City County, York County

The purpose if to solicit input from the public in the development of this plan. These jurisdictions have developed a draft Natural Hazard Mitigation Plan in order both to reduce the impact of future disasters and also meet Federal Requirements. Jurisdiction Planning Groups and AMEC Earth and Environmental will be at the following locations to discuss the planning processing and receive final public input:

Tuesday November 1, 2005 7:00-8:00 pm
Quarterpath Recreation Center 202 Quarterpath Road, Williamsburg

Wednesday November 2, 2005 6:00-7:00 pm
Tabb Library, 100 Long Green Blvd, York County

Thursday November 3, 2005 7:00-8:00 pm
Pearl Bailey Library, 2510 Wickham Avenue, Newport News

Citizens from participating jurisdictions can attend any of the three meetings listed. For further information please contact your local Emergency Management Office or Planning Department.

Hampton
[insert here]

Newport News
[insert here]

Williamsburg
[insert here]

James City County
[insert here]

York County
[insert here]

Appendix J
Acronyms Used in this Plan

Acronyms Used in this Plan

AMEC	AMEC Earth & Environmental, Inc.
ARB	Architectural Review Board
BMP	Best Management Practice(s)
CDC	Centers for Disease Control and Prevention
CERT	Community Emergency Response Team
CIP	Capital Improvements Program (York County)
CoBRA	Coastal Barrier Resource Act
CPTED	Crime Prevention through Environmental Design
CRS	Community Rating System of the National Flood Insurance Program
CZMA	Coastal Zone Management Act
DCR or VaDCR	Virginia Department of Conservation and Recreation
DMA 2000	Disaster Mitigation Act of 2000
DRC	Development Review Committee
DRU	Disaster Resistant University
EAS	Emergency Alert System
EMS	Emergency Medical Services
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPRI	Electric Power Research Institute
FAP	Flood Assistance Program (Newport News)
FAQ	Frequently Asked Question(s)
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
GIS	Geographic Information System
HAZUS	Hazards U.S. – Multi Hazard (software package)
HI	Heat Index
HMGP	Hazard Mitigation Grant Program
HMPC	Hazard Mitigation Planning Committee
HREMC	Hampton Roads Emergency Management Committee
HRPDC	Hampton Roads Planning District Commission
IBC	International Building Code
ICC	Increased Cost of Compliance
JCSA	James City Service Authority
MM or MMI	Modified Mercalli Intensity Scale
MRC	Medical Reserve Corps
MSA	Metropolitan Statistical Area
NCDC	National Climatic Data Center
NEIDS	Neighborhood Emergency Information Distribution System
NFIP	National Flood Insurance Program
NGDC	National Geophysical Data Center
NGVD	National Geodetic Vertical Datum

NOAA	National Oceanic and Atmospheric Association
NPS	National Park Service
NWS	National Weather Service
PDI	Palmer Drought Index
PDM	Pre-Disaster Mitigation
PSA	Primary Service Area (James City County)
REMTAC	Regional Emergency Management Technical Advisory Committee
RMA	Resource Management Area
RPA	Resource Protection Area
SAC	Stormwater Advisory Committee (York County)
SEAS	Shoreline Erosion Advisory Service
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
VCMP	Virginia Clean Marina Program
VDEM	Virginia Department of Emergency Management
VDH	Virginia Department of Health
VDOF	Virginia Department of Forestry
VDOT	Virginia Department of Transportation
VIPS	Volunteers in Police Service
VMRC	Virginia Marine Resources Commission
VPPSA	Virginia Peninsula's Public Service Authority
VS&WCB	Virginia Soil and Water Conservation Board
VTSO	Virginia Tech Seismological Observatory
VUSBC	Virginia Uniform Statewide Building Code
WNV	West Nile Virus

Appendix K
Public Comments and
Response to Comments Memos

Comments and Responses to the Draft Natural Hazard Mitigation Plan, dated Feb 1, 2005
Draft #1

Reviewer: Jim Murphy
Agency: City of Williamsburg

1. ***Page 81, Capability Matrix Table. Denote "0" for Number of Flood-Prone Buildings and Number of Repetitive Losses.***

Response: Corrected

Reviewer: Emily Seward
Agency: City of Newport News

1. Page 67, *Framework for the Future,* 4th bullet. Add "Port Warwick" after Oyster Point.

Response: Corrected

2. Page 68, Stormwater Program and Fees, 3rd paragraph, last sentence. Change to "The City's Department of Planning and Department of Development . . . ."

Response: Corrected

3. Page 70, Emergency Preparedness, 4th paragraph, 3rd sentence. Change phone number to "269-2910."

Response: Corrected

4. Page 70, Other Mitigation Activities, 3rd paragraph, 2nd sentence. Change to "Department of Development."

Response: Corrected

5. Page 71, Other Mitigation Activities, 5th paragraph, 5th sentence. Change to ". . . the southeast community (flood-prone) part of the City . . . ."

Response: Corrected, but left out "part" because it is redundant.

Reviewer: Jim Redick
Agency: City of Hampton

1. Page 52, Section 5.1.6, "…the planning team developed a local capability assessment for the City of Hampton." We did?? Have the Emergency Management Local Capability Assessment Reports (LCAR) been reviewed?

Response: AMEC conducted telephone and in-person interviews with planning team members to develop the capability assessment. LCAR were not reviewed, but have been requested from the City. Pertinent information from those reports will be incorporated as it relates to mitigation capability, as differentiated from emergency management capability.

2. Page 52 – Recommends we be Storm Ready. We became Storm Ready in 2004.

Response: Text removed.

3. Page 52, Capability Matrix. It would be much more informative to have the materials dated and the source of the information. For instance, Hampton has a Comprehensive Plan. What is the date on the plan? Who houses it?

Response: The matrix is intended to provide information at a glance. The date and department for the Comprehensive Plan has been added to the descriptive information below the table.

4. Page 52, Capability Matrix. "Effective Flood Insurance Rate Map Date" – why is this 1995 when data earlier in the report was 1988?

Response: The correct effective FIRM date for Hampton is 7-3-95, according to FEMA's Community Status Book.

5. Page 52, Capability Matrix. "Number of floodprone buildings" – is this info available from the info in Table 5.1.5a?

Response: Hampton's GIS staff have provided an estimate of floodprone buildings.

6. Page 52, Capability Matrix. "Number of NFIP policies = 9,792" – as of when? Info is time sensitive.

Response: Date information was added.

7. Page 53, Capability Matrix. Since this is a public plan, acronyms should be explained.

Response: Document will include an Appendix explaining acronyms.

8. Page 53, Capability Matrix. "-other? (e.g., cable override)" – remove CERT.

Response: Corrected.

9. Page 53, Capability Matrix. Please explain what "not fully" means in regards to the protection of critical facilities.

Response: Changed to "Not all facilities fully protected."

10. Page 53, Capability Matrix. "Natural Resources Inventory" – what does this include?

Response: A Natural Resources Inventory might include detailed data on (for example) habitats (threatened/endangered/otherwise), planting zones, wetland functions, watershed protection areas, areas of high soil erodibility, areas with high water tables, areas with shrink/swell soils or areas with steep slopes. GIS staff for Hampton indicated that the City did not maintain databases with inventory of this type.

11. Page 53, Capability Matrix. Please provide more data regarding the last 7 items on the capability matrix.

Response: Additional notations were added to 6 of the 7; however, since a Natural Resources Inventory was not identified, additional information was not available.

12. Page 54, section Guiding Community Documents. There is no Comprehensive Plan 2020. Remove that from the title and add a bullet that states "The City is currently working to adopt a new ten year plan, the City of Hampton Community Plan."

Response: Corrected. The final bullet was amended as requested.

13. Page 54 – Zoning & Development Standards. "The Department of Codes Compliance enforced requirements for 'substantially damaged' homes after Hurricane Isabel, but the process was exceedingly difficult and some difficult decisions had to be made."

Response: Amended as requested.

14. Page 55, the earliest that the 2003 VUSBC would be adopted is the Fall of 2005 (that's assuming that everything goes fine in the process); in each locality's section, we state April, 2005 as the effective date.

Response: Corrected.

15. Page 55, Public Education – "The City's Department of Public Works…" – there is also a Codes Academy, and info is also disseminated via the City's Neighborhood College Leadership Institute.

Response: Corrected.

16. Page 55, Emergency Preparedness - "EAS is now routinely used for…" – remove "now routinely."

Response: Corrected.

17. Page 56, Storm Ready - Should read "As of February 2005, the National Weather Service… (provided this is still accurate).

Response: Corrected.

18. Page 56, Evacuation Plan - Paragraph should start by saying: "The Virginia Department of Transportation's Phase 1 and Phase 2 evacuation routes are shown and discussed online at… . They are also available in the local telephone directories. The City emergency management and other City officials are re-examining…"

Response: Corrected.

19. Page 56, Hampton Citizen Corps and CERT Program. Remove "and CERT Program" in the paragraph title.

Response: Corrected.

20. Page 56. Replace "USA Freedom Corps" with "Virginia Corps."

Response: Corrected.

21. Page 56. "Hampton's umbrella program…" should read "Hampton's Citizen Corps includes 3 core programs: Neighborhood Watch, Volunteers in Police Service (VIPS), and Community Emergency Response Team (CERT). Medical Reserve Corps (MRC) is under development."

Response: Corrected.

22. "CERT helps communities respond…" If you are going to discuss CERT, you need to do the same for the other programs.

Response: Disagree. Added a clarification that CERT is the "core program most relevant to hazard mitigation." The other programs do not appear to have capability related to hazard mitigation.

23. Page 56. The document mentions that all substations are out of the flood zone. I am not sure of every location but the one at Fox Hill and Old Buckroe is definitely in the A7 elevation 9 zone.

Response: Corrected.

24. “The homes have not been elevated and the grants have not been approved or denied at the time this plan was prepared.” Not true. Although the first home elevation project is still in review at the Federal level, the second project was denied.

Response: Corrected.

Reviewer: Judi Riutort
Agency: York County

1. Page 94, Section 5.4.6, 4th paragraph. Change “they have” to “it has.”

Response: Corrected.

2. Page 95, Capability Matrix. Change CRS Rating from “None” to “Conditional approval – Class 9.”

Response: Corrected.

3. Page 95, Capability Matrix. Change Hazard Mitigation Plan from “Yes, Surry Siren System” to “In Process.”

Response: Corrected.

4. Page 95, Capability Matrix. Add “Route alerting plans and an automated system in the planning phase” for Emergency Notification. Add “cable override and agreement with radio station” for Other.

Response: Corrected.

5. Page 95, Capability Matrix. Change “not fully” to “partially” for Critical Facilities Protected.

Response: Corrected.

6. Page 95, Form of Governance. First sentence, change “York County” to “elected.” Second sentence, change to “. . . elected annually by the five member board”, and delete “to serve for one year.” Third sentence, change “serves” to “serve”.

Response: Corrected except for last change. “Board” is singular.

7. Pages 95 and 96, Guiding Community Documents. First sentence, change “their” to “its”. Third sentence, change “City” to “County” and delete “ordinances” after “zoning”. Final sentence, change “its’” to “its”.

Response: Corrected.

8. Page 96, Comprehensive Plan. Change title to “Charting the Course to 2015, the County of York Comprehensive Plan”. 2nd sentence, do not capitalize “Comprehensive Plan”. 7th bullet, change to “Potential Mixed Use areas identified along Route 17 and in the area of the interstate 64 Camp Peary interchange.” Final bullet, do not capitalize comprehensive plan and add “update for 2025.”

Response: Corrected.

9. Page 96, Zoning and Development Standards. First bullet, write out RPA/RMA, and add “for Chesapeake Bay protection.” 2nd full paragraph, add “the Department of” before Environmental and Development Services.

Response: Corrected.

10. Page 97, Building Codes. First paragraph, take out "In January of 2005". 2nd paragraph, 1st sentence, clarify local government department name.

<u>Response:</u> The "January of 2005" phrase has been left in the text to clarify the building codes at the time of the report. The codes will change soon, and we feel that the information should be dated for clarity. The Building Codes section was removed to the State Capabilities section and the pertinent, specific agency for each community is, therefore, not named.

11. Page 97, Stormwater Program. First paragraph, first sentence, clarify the department's name. Second paragraph, first sentence, change to ". . . when the County receives complaints/inquiries about drainage problems, staff complete a study to determine if there are easements, if it is the County's responsibility to correct the problems, and make recommendations for addressing the issue that can include developing a project plan and adding it to the Capital Improvement Plan list and ranking it with . . . ." Delete sentence beginning, "The County Board of Supervisors . . . ," and combine with previous sentence.

<u>Response:</u> Corrected, with some editorial changes to shorten sentence.

12. Page 98, Stormwater Program. Third paragraph. Change "stormwater" to "storm water".

<u>Response:</u> Industry standard is "stormwater" and York County documents and committee names also refer to "stormwater."

13. Page 98, Stormwater Program. Additional paragraph. Text provided to append to this section.

<u>Response:</u> Text appended as requested.

14. Page 98, Public Education, first paragraph. Capitalize "Website". Append to the end, "The County publishes a quarterly newsletter (CITIZEN NEWS), which is mailed to every household. The County maintains a government access TV channel using Cox Cable.

<u>Response:</u> Disagree with capitalization. Other corrections made as requested.

15. Page 98. Public Education, second paragraph. Text provided to append to this section.

<u>Response:</u> Text appended as requested.

16. Page 98. Public Education, third paragraph. Add "Department of . . ." to the first sentence.

<u>Response:</u> Corrected.

17. Page 98, Emergency Preparedness. Append introductory paragraphs on Dept. of Fire and Life Safety. Include sentence, "The following list some of the important considerations in an emergency management program: . . ."

<u>Response:</u> Text appended as requested. The sentence was modified to reflect the mitigation focus of the capability assessment.

18. Page 98, Emergency Preparedness. Add, "York County coordinates with Newport News Waterworks and Williamsburg Water to provide door-to-door notification in the inundation zone for their dams located in York County."

<u>Response:</u> Text appended as requested.

19. Page 98, Emergency Preparedness. Add radio station name in parentheses (WXGM 99.1 FM), and replace phrase beginning ". . . previous arrangements with large area . . ." with the following, "the media became

overwhelmed and summarized emergency information for the smaller media markets leaving out details residents needed for recovery activities."

Response: Text appended as requested.

20. Page 98, Emergency Preparedness, Evacuation. Reword first sentence. Add "across the Coleman Bridge" to the last sentence.

Response: First sentence was moved with the bulk of the evacuation text to the State capabilities section. Text appended as requested.

21. Page 99, Emergency Preparedness, Special Needs Program. Rewrite paragraph as indicated, and add paragraph on CERT as provided.

Response: Text rewritten as requested.

22. Page 99, Emergency Preparedness, Other Mitigation Activities. Add sentence about Hazard Mitigation Grant Program funding in 2000 for $7,937 to install impact resistant glazing in windows of EOC. 1st paragraph, 1st sentence, add "the" before "substantial damage regulations. . . ." 2nd paragraph, last sentence, append, "This brings it above the 100-year flood elevation."

Response: Text rewritten as requested with slight change to last sentence.

23. Page 99, Emergency Preparedness, Other Mitigation Activities. Append text provided regarding Household Chemical Disposal program, generator back-up power, and Capital Improvements Program.

Response: Household Chemical Disposal program and generator back-up power text appended. Capital Improvements Program projects are moved to recommended mitigation actions.

Comments and Responses to the Draft Natural Hazard Mitigation Plan, dated June 7, 2005
Draft #2

Reviewer: Jim Murphy
Agency: City of Williamsburg

1. ***Page 139, Action Item #1. Reword Schedule to denote "within 3 years of plan adoption."***
   Response: Revised.

2. ***Page 142, Action Item #4. Cost Estimate of $25,000 per shelter is acceptable. Shelters will be ARC certified.***
   Response: Amended to include new information.

3. ***Page 143, Action Item #5. Reduce cost to $100,000, and note that existing hiking/biking trails will be widened and improved to provide firefighting access. Increase implementation to 5 years from plan adoption.***
   Response: Revised.

4. ***Page 145, Action Item #7. Reword to indicate that this is a continuation of ongoing programs in both Williamsburg and Colonial Williamsburg. Remove references to history of drainage system.***
   Response: Revised.

5. ***Page 145, Action Item #8. Remove this action item, as it does not accurately reflect existing conditions.***
   Response: Revised.

6. ***Page 145, Action Item #8. Add Action Item for Colonial Williamsburg's Annual Tree Maintenance Program.***
   Response: Action Item appended.

7. ***Page 146, Action Item #9. Add Action Item for Disaster Resistant University planning assistance to the College of William and Mary.***
   Response: Action Item appended.

Reviewer: Cindy Greczek
Agency: Colonial Williamsburg Foundation

8. ***Page 145, Action Item #7. Revise last sentence of Issue/Background to read: "Colonial Williamsburg Foundation directs performs an annual storm drain maintenance program in the Historic Area, under the direction of the City of Williamsburg."***
   Response: Revised.

9. ***Page 145, Action Item #7. Revise potential funding to indicate that*** **costs for projects in the Historic Area are shared with the Colonial Williamsburg Foundation.**
   Response: Revised.

Reviewer: Jim Redick
Agency: City of Hampton

10. **Pg 4, 2.0 Community Profile – Population, 2nd paragraph: "Recent population projections…" "Recent" should be defined. Is it 2004? 2000? 1990? How recent is it?**
    Response: A wholesale revision of this section better explains recent projections and provides some more interpretation.

11. **Pg. 4, 2,1 City of Hampton – If you're going to list all of the other installations, Langley AFB is also in the City of Hampton.**

Response: A wholesale revision of this section provides a better summary of the City's history, and includes a brief discussion of Langley's Field's place in aeronautical history.

12. **Pg. 9, Step 1: Get Organized, 3rd sentence should read: "With the Committee's commitment to participate, the first step… (remove AMEC). The Peninsula is the lead organization, and the customer. AMEC is the contractor.**
    Response: Revised; also removed prepositional phrase beginning "with the Committee's commitment . . .", as the phrase states the obvious.

13. **Pg. 9, Step 2: Plan for Public Engagement – Hampton's web address should read http://www.hampotn.gov/eoc. Also, confirm with Newport News, but I believe "The Project Manager's Office" is the Office of Emergency Management, which is reflected in the previous paragraph, Step 1.**
    Response: Revised.

14. **Pg. 10, Relationship with Other Community… "The Committee identified a variety of comprehensive planning mechanisms such as land use and master plans, emergency response and mitigation plans, and municipal ordinances and building codes…" Too many "and's."**
    Response: Revised.

15. **Pg. 10, bottom box – "2003 Hurricane Isabel Damage Survey Report (DSR)" What is a DSR? Should this read Damage Assessment Report?**
    Response: Revised.

16. **Pg. 11 – The page states this template would be used for the community assessments, etc, but when you get to them, they don't.**
    Response: The section was substantially revised and the template was put in a narrative form that more accurately represents the information provided in Section 5.

17. **Pg. 11, Critical Facility Identification – Where did you get this definition? It may not be consistent with definitions used by utility companies or other entities.**
    Response: This definition of critical facilities is generally recognized by FEMA for the purposes of mitigation planning. The phrase, "For the purposes of mitigation planning," was appended to the definition for clarity.

18. **Pg. 15, 4.1 Hazard Identification – Still not sure why Biological Hazards/Epidemics is in a "natural" hazard mitigation plan.**
    Response: Hazards are typically designated as "natural" or "manmade". While there are some biological hazards that may fall in the manmade category (eg, chemical weaponry), there are others that fall in the natural category (eg, West Nile Virus). WNV is caused by a natural process, not through fault of man.

19. **Pg. 15, "There have been 34 Presidential disaster declarations in Virginia since 1969 (Table 4.1)" – Since this is a Peninsula plan, how many of these declarations affected the Peninsula?**
    Response: Revised w/updated information and declaration numbers. Included column regarding Peninsula impacts. Attempted to gather additional information on early VA declarations.

20. **Pg. 16, 4.1.1 Earthquakes – Why start with earthquakes? Why not highest probability to least, or alphabetical order? Also, each jurisdiction has differing vulnerabilities, risk, etc. Each jurisdiction should have their own rating of each hazard in their jurisdiction-specific tab of the plan.**
    Response: Revised. Hazards re-ordered roughly according to vulnerability.

21. **Pg. 17, top graphic – what does this mean?**
    Response: Revised. Earthquake graphics were revised following an interview with Bill Sammler, NWS.

22. **Pg. 17, last paragraph - "Historical data is supportive of the moderate earthquake risk assessment for Virginia and the Peninsula area." Define moderate in relation to risk analysis. Also, the end of the paragraph refers to map C-1. Where is it?**

Response: Revised. Earthquake graphics and text were revised following an interview with Bill Sammler, NWS.

23. **Page 18/19, Table 4.1.1 – Earthquake info for PA, TN, WV, and MD – How does this impact the Peninsula?**
Response: Revised. Earthquake graphics and text were revised following an interview with Bill Sammler, NWS.

24. **Pg. 20 – "Yorktown has taken a proactive stance…" So have other jurisdictions.**
Response: Revised.

25. **Pg. 21 – Figure 4.1.3a – Who is UVCD?**
Response: Revised.

26. **Pg. 22 – Table 4.1.3 – There are 12 lightning occurrences listed, but the previous paragraph on page 21 says 10.**
Response: Revised. Thunderstorm and lighting graphics and text were revised following an interview with Bill Sammler, NWS.

27. **Pg. 23 – second to last paragraph – "There have been numerous (add "urban and") flash floods…**
Response: Revised.

28. **Pg. 24 – sentence above Table 4.1.6a – For further information regarding community-specific dams, please contact the office of the local emergency services coordinator??**
Response: Revised.

29. **Pg. 28 – first paragraph refers to Map A-2. Where is map A-2?**
Response: Revised.

30. **Pg. 28 – Table 4.1.8b – Why was a TS in 1961 unnamed?**
Response: Revised.

31. **Pg. 33, 4.1.11, second paragraph – Direct sunlight dries vegetative fuels, etc… "conductive" should be "conducive"**
Response: Revised.

32. **Pg. 43 – Department of Housing and Community Development – this title should be in bold text.**
Response: Revised.

33. **Pg. 46 – Military Installations – Should not put a negative light on installations.**
Response: Revised language and relocated this paragraph to indicate that military installations liaisons were invited to participate in the planning meetings.

34. **Pg. 47, section 5.1.1 FEMA Flood Insurance Study: Since this is a public document, "100- and 500- year flood" should be defined.**
Response: Revised.

35. **Pg. 48, 5.1.2 Hurricanes – City of Hampton, last two paragraphs – was this in Hampton? If this is a jurisdiction specific section, then get down to specifics rather than the global picture. Why was flood insurance policy data removed in this draft? It would be the basis for showing the benefit of CRS!**
Response: The community specific discussion of hurricanes was significantly rewritten using best available data. If additional data regarding damages, injuries, and other specific numbers are available from the City, the City must provide it to AMEC in order for it to be included. Flood insurance policy data regarding the benefits of CRS was replaced in Hampton's Action Item #1.

36. **Pg. 49, 5.1.3, Tornados, first paragraph – "Denis" should be "Dennis"**

Response: Revised.

37. **Pg. 50, 5.1.5, Vulnerability Assessment – Hurricanes, flooding, tornado, and wildfires have already been discussed. Now we are getting to the assessment?**
Response: The hazard ID and the vulnerability assessment are separate. See introduction to Section 4 for a summary of the two sections. However, Section 5.1.5 and the applicable sections for other communities have been rewritten to smooth the transition.

38. **Pg. 50, Table 5.1.5a – What is "other?" Is this government facilities? What is "No values?" Is this vacant land? Need to be defined.**
Response: Since this data was provided by Hampton, the definitions were requested from Allan Lambert on 9/21/05, and Libby Griebel on 9/32/05. Table revised to be as specific as possible, given known parameters in conjunction with guidance from Mr. Lambert and Ms. Griebel.

39. **Pg. 51, Repetitive Loss Areas – Needs to be Hampton-specific, not global.**
Response: Revised to include additional details on Hampton's repetitive loss data. The following sentence was added, "City planners have identified specific areas of the City that contain large numbers of repetitive losses; however, in order to protect the privacy of those policyholders, that information cannot be shared in this plan."

40. **Pg. 52, Hurricane Vulnerability Analysis – It should be emphasized here that this does NOT depict flooding damage. Table 5.1.5b – "Total $ Value Exposed Structures" – from wind only**
Response: Revised table title and preceding paragraph.

41. **Pg. 53, Critical Facilities Analysis, second paragraph: The inventory of critical facilities for the City of Hampton (not Newport News).**
Response: Revised.

42. **Pg. 53, Table 5.1.5e: Text should all be uniform – some are all caps, some are not; Change 7-11 to Police Substation; and Remove Buckroe Skills Center.**
Response: Revised for all communities and the appendices.

43. ***Pg. 54, 5.1.6 – "…the planning developed a local capability assessment for the City of Hampton." This terminology could be confused with an LCAR (Local Capability Assessment Report).***
Response: Revised to read, ". . . assessed Hampton's existing mitigation capabilities."

44. ***Pg. 54, Capability Matrix: Hampton does have a Floodplain Manager, Fred Whitley.***
Response: The key word in the matrix is "Certified." The Association of State Floodplain Managers has established a national program for professional certification of floodplain managers. Those candidates who pass the test and meet certain minimum professional qualifications can become Certified Floodplain Managers. Mr. Whitley is not listed on the official list of CFMs for Virginia at www.floods.org.

45. ***Pg. 55, Capability Matrix, Local Emergency Operations Plan: Why is CERT mentioned here?***
Response: Revised. CERT was removed from EOP and placed under Public Information Program.

46. ***Pg. 55, Hazard Mitigation Plan – should read "Pending"?***
Response: Revised.

47. ***Pg. 55, Form of Governance – Council–Manager Form of Government***
Response: Revised. A sentence was added to the beginning clearly indicating that Hampton has a Council-Manager Form of Government. The title of the section cannot be changed because the five jurisdictions covered by the plan do not all have Council-Manager forms.

48. ***Pg. 56, bullet beginning with "The City is currently working to adopt a new ten year plan, the City of Hampton Community Plan. Remove sentence beginning with "The new plan will be based… replace it with "This plan will be adopted in the Fall of 2005."***

Response: Revised.

49. ***Pg. 56, last sentence before Stormwater Program and Fees: "The Emergency Management" should read "The Office of Emergency Management"***
Response: Revised.

50. ***Pg. 57, Public Education: website should read http://www.hampton.gov***
Response: Revised.

51. ***Pg. 57, Public Education, second paragraph, 3-1-1 information: Residents (add within the City limits) dial 3-1-1… 3-1-1 can also be accessed by residents with cell phones, or who are outside of the City limits by calling 727-8311.***
Response: Revised.

52. ***Pg. 57, Public Education: Emergency Preparedness information is also disseminated through the City PIO's eNews, free e-mail briefs about what's happening in Hampton, and the City's local cable channel, Channel 47.***
Response: Revised.

53. ***Pg. 58, Other Mitigation Activities, second paragraph: At the time of this report, the project is in the procurement phase.***
Response: Revised.

54. ***Pg. 111, 6.0, second paragraph – "Each HMPC member was provided (remove with) a written…"***
Response: Revised.

55. ***Potential Funding: AMEC includes the funding sources that we provide, or states HMGP 75%; City of Hampton 25%. The expectation was that AMEC would let us know what other sources were available.***
Response: Additional *potential* funding sources have been identified and added.

56. ***Schedule: Since these are recommended, not required actions, I think it would be appropriate to remove the Schedule pieces on all action items.***
Response: FEMA guidance and the review crosswalks require that a timeframe for implementation be included. In Section 5.5, 1st paragraph, 2nd sentence, we added the following phrase to address this comment: "the schedules and cost estimates are not binding and do not imply that the community must complete each action."

57. ***Pg. 120, Responsible Party – "Hampton's NFIP administrator" – We don't have an NFIP administrator.***
Response: Please see Hampton comment number 43 above and comment 59 below. Any community participating in the NFIP must have an NFIP or floodplain administrator. Mr. Fred Whitley is the designated Floodplain Administrator or Floodplain Manager for the City of Hampton, according to the Virginia Dept. of Conservation and Recreation. We denoted "Floodplain Management", rather than NFIP Administrator, to address this comment.

58. ***Pg. 120, Cost Benefit: "resulting in approximately $219,000 (add "annual") savings"***
Response: Revised.

59. ***Pg. 121, Other Alternatives, Need to reword first sentence.***
Response: Revised.

60. ***Pg. 121, Responsible Office – Again, we do not have an NFIP administrator.***
Response: Please see comments 43 and 56 above. We denoted "Floodplain Management", rather than NFIP Administrator, to address this comment.

61. ***Pg. 122, Responsible Office includes Codes Compliance, Procurement, Public Works, Floodplain Management. Cost estimate is more around $40,000 - $60,000 per structure – remove total of $500,000. Cost benefit - …"when structures are elevated (replace "to or" with 1 foot) above Base Flood Elevation."***
Response: Revised.

62. ***Pg. 123: Issue / Background – Outside 100-year floodplain. Responsible Office – Hampton City Schools, NFIP Administrator (?), Office of Emergency Management. Schedule – After first sentence, include "Grant denied. Future funding opportunities will determine schedule to complete this item."***
Response: Revised.

63. ***Pg. 124, Action Item 5 – based on BRAC, may want to include Buckroe through Ft. Monroe. Responsible Office – NFIP administrator in brackets, not consistent with previous statements. Schedule – see previous comment on pg. 123. (Grant denied…)***
Response: Revised.

64. ***Pg. 125 – Potential Funding – DHS grants. Schedule – Grant denied… (see pg. 123, 124)***
Response: Revised.

65. ***Pg. 126 – Wiring existing shelters and critical facilities (this is fine). Approximately 20 facilities (add and 20 pump stations) will be prewired for generator power. Responsible Office – Include Hampton City Schools, remove American Red Cross. Cost Benefit – Should read "Providing ability to contract for and install back generator power to shelters… Potential Funding – include CIP, other grant opportunities… Schedule – Add "Grant denied… (see pages 123, 124, 125).***
Response: Revised.

66. ***P.127 – cost estimate – add "there would be a cost to the builder to elevate an additional 2'."***
Response: Revised.

67. ***Pg. 128 – Issue/Background – The answer to your question depends on the scenario. Certainly volunteers could conduct windshield assessments, but also report post-event conditions to the EOC, serve as a means of communications throughout the neighborhoods, traffic control, etc. This is where CERT / Citizen Corps come in.***
Response: Revised.

68. ***Pg. 129, Action Item #10, Issue/Background: First sentence – instead of citing specific areas in the City, just say there is a city-wide history of flooding. Other Alternatives Considered: Should read "No action to preserve or create open space in the floodplain may result in residential…" Cost Estimate: Not high enough. Potential Funding – define HMGP, PDM, FMA, CDBG.***
Response: Revised as requested, except all acronyms will be fully described in an appendix to this document. Included an additional $1,000,000 in Cost Estimate.

Reviewer: Wilton Bobo
Agency: James City County

69. ***Pg. 105, Number of Floodprone Buildings is 200.***
Response: Revised.

70. ***Pg. 107. 2003 Comprehensive Plan, last paragraph. Add Powhatan District after Berkeley in first sentence.***
Response: Revised.

71. ***Pg. 108. Public Education, last paragraph. Change Environmental Division to Development Management.***
Response: Revised.

Reviewer: Emily Flannigan
Agency: Newport News

72. Pg. 68 and 69. Remove question marks from Capability Matrix.
Response: Revised.

73. Pg. 71, Emergency Preparedness, Storm Ready. Revise 1st sentence to read, "Newport News was one of the first 5 communities in Virginia to be Storm Ready. Storm Ready is a nationwide . . . ."
Response: Revised.

74. Pg 72. Last paragraph. Remove the phrase, "outside of the floodplain."
Response: Revised.

75. Pg. 131. Action Item #3, Action Description. Add phrase, "which are certified by the American Red Cross" to clarify.
Response: Revised.

76. Pg. 131. Issue/Background. Add the following sentence at the end, "During Hurricane Isabel, the shelters were left without power."
Response: Revised.

77. Pg. 132. Issue /Background. Add the following sentence at the end, "Future plans for acquired areas include park uses in allowed floodway."
Response: Revised; modified wording slightly to read "regulatory floodway."

78. Pg. 132. Schedule. Add the following sentence at the end, "To date, about thirty homes have been acquired through the FAP."
Response: Revised.

79. Pg. 135. Responsible Office, include Planning. Cost Estimate, denote "Staff Time."
Response: Revised.

80. Pg. 136. Responsible Office, include Emergency Management. Cost Estimate, denote "$25,000."
Response: Revised.

81. Pg. 138. Action Item #10, include introductory phrase, "Upgrade drainage system maintenance and increase maintenance frequency . . . ."
Response: Revised.

82. Pg. 138. Issue Background, include final phrase, "system, which has resulted in flooding problems in low-lying areas such as City Line Apartments. Presently, City crews visit hot spots during intense rain storms resulting in extra man power and additional hours."
Response: Revised.

83. Pg. 138. Include Action Items 11 (Flood Hazard Awareness Program) and 12 (Community Rating System participation).
Response: Revised.

Reviewer: Judi Riutort
Agency: York County
Note: Ms. Riutort provided comments via an edited document. Her version was wholly included in the main document, and the most important comments are summarized below.

84. Pg. 147. Responsible Office, use "Dept of Environmental and Developmental Services, Building Regulations". Schedule should indicate, "Implementation contingent on funding and staffing availability."
Response: Revised.

85. **Actions Items 2 and 3. Reorder items so that 2 and 3 become 4 and 5, and vice versa.**
Response: Revised.

86. **Pg. 148. Reword first action item as indicated in revised document provided to AMEC. Reword Issue/Background and include Office of Emergency Management, and Department of Fire & Life Safety under Responsible Office. Cost estimate should be increased to $120,000. Revise Schedule to read, "Implementation contingent upon . . . ."**
Response: Revised.

87. **Pg. 148. Reword 2nd action item, Issue/Background, and Other Alternatives Considered. Responsible office should be County administration, Planning Division and the York Co Board of Supervisors.**
Response: Revised.

88. **Pg. 149. Reword Responsible Office for first action item on page. Change Priority to "High". Change Schedule to "Ongoing."**
Response: Revised.

89. **Pg. 149. Reword Issue/Background for the 2nd action item on page. Take out sentence referring to VDOT maintenance. Change Priority to "High. Increase Cost Estimate to $5,000,000, reword Cost Benefit, and include VDOT Revenue Sharing Program funds as a Potential funding source.**
Response: Revised.

90. **Pg. 149. York County included 8 additional action items in their comments which were included in the revised draft of the hazard mitigation plan.**
Response: Revised.

Reviewer: Bill Sammler
Agency: NWS Wakefield Office

91. **Hurricane Map – Hurricane track arrows are 180 degrees opposite what they should be. Also, there is considerable difference between the track data and the impact data in the body of the text, most likely due to the fact that most tropical systems which affect the Peninsula do NOT pass directly over the Peninsula.**
Response: Revised using NOAA CSC mapping tool.

92. **Earthquakes (pp. 17) – data should also be derived from the USGS Virginia page, which has more current information.**
Response: Revised using data from USGS Virginia page and the Virginia Tech Seismological Observatory data. Table revised by striking non-Virginia quakes and adding recent data collected from various sources.

93. **Thunderstorms (pp.21-22) – VA averages 40-50 thunderstorm days per year (vs. 35-45). A better lightning strike density map should be available from the Internet. The use of a 1 year sample as a climatology (Figure 4.1.3a) is simply not valid. In addition, the last paragraph on page 21, and the table on page 22 do not depict lightning strikes, but depict incidents of lightning strike damage and/or deaths since about 1990. This is likely only a fraction of the actual damage, and deaths/injuries during that time. In addition, there is no data on hail/high wind damage/deaths as a result of severe thunderstorms. This data can be obtained by using the SVRPLOT2 software available from the Storm Prediction Center in Norman OK.**
Response: Revised text as indicated. Another lightning strike density map could not be located; however, discussion was added and the figure title revised to indicate that this is a 1-year climatology only. SVRPLOT was used to create maps in Appendix C showing hail, high winds, and tornadoes as suggested.

94. **Extreme Heat (pp22-23) – Table 4.1.4a is a Heat Index table, not a table of temperature vs. RH. Suggested to AMEC that a 30% RH column be added. This is NOT a valid suggestion, as the NWS Heat Index table ends at 40%.**

Response: Revised table title and added column descriptors.

95. **Flooding (pp 23-24) – 3rd full paragraph on page 23, suggest starting with "There have been numerous urban and flash floods…", as not all the flooding has been flash flooding. In fact, Isabel was not a flash flood due to rainfall, but Floyd had flash flooding, urban flooding, and longer term river flooding associated with it.**
Response: Paragraph was substantially revised.

96. **Drought (pp. 24-26) – Need to discuss the 2000-2002 drought, which was the most significant since 1931 for most of VA. Attached are a couple of graphics from that time period. Eliminate graphic at top of page 26. It's not representative of drought.**
Response: Drought section was substantially revised to include data on 2000-2002 drought, and use U.S. Drought Monitor rather than Palmer Drought Severity Index.

97. **Hurricanes (pp. 26-28) – Lots of re-wording needed in the descriptive section (pages 26-27). 1933 Hurricane and Hurricane Hazel were missed completely, probably due to the lack of data in Storm Data, which really isn't a good source for pre-1980 hurricane impact information. Newspaper clipping/archives, etc. are much better, even though more work is required to obtain this info. I have attached a document we prepared locally that might help. Also suggest using a larger radius around the Peninsula (say 150 miles from the center of the Peninsula) to map hurricanes. This will be more representative of the storms that have impacted the region. NOAA's Coastal Services Center (CSC) has a hurricane track web site that should prove useful for this.**
Response: Hurricane section substantially revised. Mapping was not extended to 150 miles due to the community's desire to focus more closely on the Peninsula. NOAA CSC mapping site used to provide new mapping.

98. **Also Table 4.1.8b, Donna (1960) is missing. Ginger (1971) is included twice, Floyd was a TS, Dennis (1999) is misspelled, Isabel was an H1.**
Response: This table was deleted. Tables in Appendix C were edited to remove duplications.

99. **Nor'easters (pp. 29-30) – Not sure where the Dolan-Davis rating scale came from, and whether it's used operationally. We do not routinely use it.**
Response: This section was revised. Dolan-Davis scale remains in the plan, but a note was included that NWS and other media do not routinely use it. The table remains an insightful tool for describing varying degrees of damage.

100. **Tornadoes (pp30-32) – Need to use SVRPLOT to map occurrences, rather than using Barbara Watson's 1950-2000 map. Fujita scale is truncated at F4, should go through F5. In hurricane spawned tornadoes (table 4.1.10c), 5 tornadoes occurred on the peninsula with Gaston, not 1. There is also a discrepancy between the data showing hurricane occurrences and the data for hurricane spawned tornadoes.**
Response: This section was substantially revised. Table 4.1.10c was removed, and the information on associated hurricanes was added to the previous table to integrate the two databases and make the information more pertinent to the Peninsula. SVRPLOT maps for tornados, damaging wind, and hail were added to the Appendices.

101. **Wildfires (pp. 33) – Do not understand the meaning for the paragraph above Table 4.1.11a.**
Response: The paragraph in question was removed. Table of fire risk was revised to add land area w/in each community.

102. **Winter Storms (pp 34-36) – Why aren't most of the storms listed in Table 4.1.12a also in the Nor'easter table (4.1.9b)? Most of the winter storms listed in 4.1.12a are also nor'easters.**
Response: The nor'easter table was revised to include those winter storms *known* by editors to also be nor'easters.

103. **Sections 4.1.16/4.1.17 (pp. 38-39) – Section 4.1.16 needs to be re-worded, as the message is unclear. Table 4.1.17a is confusing to me, and I need to understand the logic behind the Hazard Level designations.**

Response: Text from 4.1.16 was moved forward in the document to ensure that this discussion is seen prior to the multi-hazard identifications, and readers understand that hazards can be interrelated. The hazard level designations in Table 4.1.17a were reviewed by the editors; however, ultimately, the team members themselves came up with the rankings and hazard levels, and the editors do not feel justified in changing them w/out community input.

104. **Jurisdictional Comments – Similar data issues appear to exist in the individual jurisdiction data. There appears to have been multiple data sources used, but little cross-checking between sources to ensure the data is complete, reasonable and accurate.**
 Response: The individual sections were reviewed and revised as appropriate.

Comments and Responses to the Draft Natural Hazard Mitigation Plan, dated Sept 30, 2005
Draft #4

Reviewer: Jim Redick
Agency: City of Hampton

1. **Pg. K-2. Mr. Redick's name was misspelled in this appendix.**
   <u>Response:</u> Revised.

2. **Pg. 9, Section 2.1. Reword second sentence of first paragraph to read, "The area now occupied by Hampton was first noted by English colonists. . . when they visited an Indian village called Kecoughtan."**
   <u>Response:</u> Revised.

3. **Pg. 148, Recommended Action #8. Reword action to include EM on site plan review, review of all development documents, processing Elevation Certificates and developing new forms for (eg) substantial damage.**
   <u>Response:</u> Revised.

4. **Mitigation recommendation #1 – elevate flood-prone homes. Generalize, don't specify 21 homes. This will be an ongoing strategy.**
   <u>Response:</u> Revised recommended action #3, and the Schedule notation, as well.

5. **Hurricane Dennis is mentioned under Tornados in Hampton, but not hurricanes. As Dennis stayed off the shore, it produced a good deal of rain and saturated the ground – allowing Floyd to cause more havoc.**
   <u>Response:</u> Revised. Also located and included local rainfall totals for Dennis and Floyd.

<u>Hampton Map Comments</u>

6. Please add a label at FR12 that indicates "City Hall".
   Response: Revised.
7. With regard to street names, add as many as possible to still make it legible.
   Response: Revised to the extent possible. Major roads where already included, however added a few more less primary roads. If more are added, clutter issues will develop.
8. Please add a label at FR12 that indicates "City Hall".
   Response: Revised.
9. Please add Hampton Roads Convention Center and Hampton Coliseum.
   Response: This comment was overlooked and will be addressed in the next revision.

Reviewer: Randy Hildbrandt et al (city officials meeting 10/12/05)
Agency: City of Newport News

10. **Newport News Mitigation Action Item #5. Remove this item as it is an ongoing program with sufficient funding. Waterworks does not plan to devote additional funding.**
    <u>Response:</u> Revised

11. **Mitigation recommendation #10. City Line flooding is not a result of inadequate drainage maintenance. Revise wording.**
    <u>Response:</u> Revised

Reviewer: Mostafa Sabbah
Agency: City of Newport News

12. **Pg. 151, Action Item #2. The City does not collect completed Elevation Certificates but collects data from the ECs. Engineering should be added to the responsible parties.**

Response: Revised.

13. Pg. 152, Action Item #3. Engineering should be added to the responsible parties. This is currently the subject of a major study being managed by Engineering. Costs seem VERY low. Potential grant funding is helpful.

Response: Revised. Increased costs substantially.

14. Pg. 152. Action Item #4. The $200K cost estimate represents only the annual City contribution and does not include FEMA funding obtained annually.

Response: Revised to read "$200,000 annual City funding, plus any grant funding that may become available. Program can be expanded based on available funds."

15. Pg. 155, Action Item #7. Engineering and City Attorney should be added to the responsible parties.

Response: Revised.

16. Pg. 157, Action Item #10. The background misrepresents maintenance deficiency as the cause of City Line flooding, which is actually more a function of tidal influence. It is unclear whether recent significant staff and equipment upgrades were considered in this recommendation.

Response: Revised. Removed reference to $1.30 per month and left it up to future stakeholders to set fee increase.

17. Pg. 157, Action Item #11. Engineering is in discussion with Codes about integrating the building permit process with the City GIS, which would allow for direct linkages with mapping including the FIRM mapping. By including more detailed data, such as a full EC, in the application and approval process, we expect to increase the level of awareness significantly.

Response: Revised to include discussion of the plans referenced above.

Reviewer: Stormwater Division, Stephen Land and Emergency Management, Emily Flannigan
Agency: City of Newport News

18. New Action Item #13. Mr. Land and Ms. Flannigan provided a new Action Item regarding floodproofing of 4 pump stations in the 100-year floodplain.

Response: Revised to incorporate new Action Item.

Reviewer: Fran DeMarco
Agency: Homeowner, City of Newport News (at Public Meeting #8, 11/2/05)

19. Table 5.2.2. During Hurricane Floyd there was significant flooding in the northern part of Newport News, near Newport News Park. There was a townhome community where many families were affected by flooding up to the 2nd floor of their homes. I understood it was a drainage problem. The Hampton Roads Chapter of the ARC might be able to provide more details.

Response: Revised to include discussion of the townhomes, and to include newly discovered data on rainfall amounts in Newport News.

Newport News Map Comments

20. Check once more for symbols and labels overlapping.

Response: Overlapping symbols were not moved due to the spatial inaccuracies that would be created. Review of overlapping labels has been performed and several overlapping labels were repositioned.

21. Remove trailer parks.

Response: Revised.

22. Nursing home symbol on legend isn't quite the same as the symbol

Response: Revised. Same symbol is represented in legend and map; however, tried to enlarge symbol in legend to make more visible.

23. Symbols layers need to be on top of water layer. East end and Mercury Blvd, there are some symbols obscured by water

Response: Revised.

24. Label creek names, from left to right:

a. Along James City Co border, it's Skiffe's Creek
b. Upper left near FR5, its Lee Hall Reservoir
c. Next creek emptying into Warwick River near PS54, is Toney Run
d. Next creek near PS 108 is Lucas Creek
e. Deep Creek is labeled
f. Next creek is Fisher's Creek (near PS 92)
g. Next waterbody is Lake Maury (near PS 22)
h. Along the northeastern border w/York County is the Big Bethel Reservoir
i. Along the boundary with City of Hampton, near the 90 degree angle and PS 96 is Newmarket Creek
j Waterbody near PS 125 is Salter's Creek

Response: Revised.

Reviewer: Bert Geddy
Agency: City of Williamsburg

25. Revise Section 5.3.1 to include data on June 63 dam break, and Aug 89 rain event.

Response: Revised. Requested more info from B. Sammler, NWS, and will add what becomes available in time.

26. Pg. 91. Listing of "designated growth/redevelopment areas" should not include College Woods.

Response: Revised.

27. Pg. 84, Section 5.3.2. Second paragraph should be revised in accordance with the recommendations above for Section 5.3.1.

Response: Revised.

28. At PHMPC meeting, Mr. Geddy and Ms. Morgan discussed adding an action item for requesting a review of the floodplain management ordinance by VaDCR.

Response: Revised.

<u>Williamsburg Map Comments</u>

29. Add Lake Matoaka

Response: Revised.

30. Delete Water Tower 521, as it is the same as WT 548 3. PS 528 and an unlabeled pump station on the far east side. The symbols got cut off. Is there a way to put these on top of the county layer? Add label for the unlabeled PS.

Response: Revised.

Reviewer: Richard Luzinski
Agency: Homeowner, York County (at Public Meeting #8, 11/2/05)

31. James City County portions of the plan. The plan seemed thorough for "natural" events. But because of our location, planning for an event in Surry [Nuclear Power Plant] or the Naval Weapons Storage Depot in York [County], I feel, should have been taken into consideration.

Response: Mr. Luzinski's comment was discussed with local planners at the meeting. The focus of this plan is natural hazards. Local communities anticipate that the five-year update of this initial planning effort will provide opportunities to more fully integrate the multiple operations plans for individual events with natural hazard mitigation planning.

Reviewer: Wilton Bobo
Agency: James City County

32. Pg. 95, Section 5.4.1. Refine discussion of flooding to show that JCC is susceptible to tidal and non-tidal flooding, not just storm surge.

Response: Revised

33. **Pg. 107, Other Mitigation Activities. Third paragraph should be revised to indicate that Jamestown *Elementary* School and Stonehouse Elementary Schools are also prepared for an emergency generator.**
    Response: Revised

34. **Pg. 167, Action #1. Comments from AMEC and Mr. Bobo reflect a need to clarify that the Chickahominy Haven project is coincident with addressing repetitive losses.**
    Response: Revised

35. **Pg. 170, Action Item #6. Include discussion that the county has begun working with nursing homes, assisted living facilities, private schools and daycare centers on mitigation and disaster recovery.**
    Response: Revised

<u>James City County Map Comments</u>

36. Show the railroad continuing through W'burg and York Co as you did with the main interstate.
    Response: Revised.

Reviewer: Lou Lafrenayz,
Agency: Homeowner, York County (at Public Meeting #8, 11/2/05)

37. **Section 5.5.1. Mr. Lafrenayz provided general background on additional flood events and some urban flooding/drainage issues in York County and along the Newport News boundary at Little Brick Kiln Creek.**
    Response: Revised report to include discussion of the flood events with data provided, and discussion of water level management practices at Bethel Reservoir and Newport News Reservoir.

Reviewer: PHMPC Team Member
Agency: York County

38. **Pg. 176, Action Item #4. Revise action description, issue/background and cost estimate in accordance with revised text provided.**
    Response: Revised with minor editing.

Reviewer: Judi Riutort
Agency: York County

39. **Pg. 112, beginning of last paragraph. The parcel layer is now up to 25,100. If a specific number is included, then we should state a date or fixed point in time.**
    Response: Revised to reference data from Spring 2005.

40. **Pg. 121, Guiding Community Documents, 1st paragraph. Change "its'" to "its".**
    Response: Revised.

41. **Pg. 122, Zoning and Development Standards, 3rd line of 1st main paragraph. Delete "a".**
    Response: Revised.

42. **Pg. 116, Critical Facilities. Correct subject verb agreement in 1st sentence of 2nd paragraph.**
    Response: Revised for each community discussion of critical facilities.

43. **Pg. 116, Table 5.5.5d. The last entry is coded as "RE", and there is no RE in Appendix E, list of codes.**
    Response: Revised by deleting Yorktown Waterfront from Critical Facilities. Recreation facilities should not be listed as critical facilities.

44. **Pgs 117-120. Delete facilities as indicated on marked up sheets.**

Response: Revised.

45. **Pg. 120, Table 5.5.6. The Land Use Plan is part of the Comprehensive Plan, and the Class 9 CRS rating is now certified.**
    Response: Revised.

46. **Pg. 122, bulleted areas of growth and development. Delete "growth/redevelopment" and add "but not limited to". Reword 3rd bullet as indicated on markup.**
    Response: Revised.

47. **Pg. 124. The font of subtitle "Emergency Preparedness" is incorrect.**
    Response: Revised.

48. **Pg. 125. Add another subheading "Warning" after "the County's Department of Fire and Life Safety:"**
    Response: Revised.

49. **Provide a summary of AMEC's role in the planning process. Recommend inside front cover.**
    Response: Provided summary of AMEC's role in the Executive Summary.

50. **Ms. Riutort commented on critical facilities tables with instructions to remove some facilities that do not meet the definition of "critical".**
    Response: Revised. However, in Appendix E, first table, "DC" and "CL" cannot be removed because Newport News chose to keep these facilities on their maps.

<u>York County Map Comments</u>

51. Top center, label should read "Gloucester County", not "Cloucester"
    Response: Revised.
52. Put the water label on top of the floodplain layer so that we get some semblance of a shoreline. This should be applied to all communities.
    Response: Revised; but water layer is probably not what communities thought it would be.
53. Remove all hazardous materials from map and legend (and report.)
    Response: Revised.
54. "Poqueson River" must be spelled "Poquoson River" and put on the water, not on land (or add an arrow)
    Response: Revised.
55. Since orientation is not north-up, the symbols are all cock-eyed. Please rotate symbols.
    Response: Symbol orientation was created with initial set-up of map. Currently we do not have a quick fix to this issue as additional research will be needed for a resolution. This issue has not been addressed due to time constraints.

Reviewer: Kris Keyes
Agency: Newport News Waterworks

56. **Dams and water towers in JCC and Williamsburg must be removed.**
    Response: These facilities have been removed from the plan and tables, and will be removed from the maps when the final maps are produced.

57. **Page 153**, **Rec Action Item #5, Issue/Background**: The first two lines should be changed to read as follows. The other lines in the paragraph should remain the same. "Department of Public Utilities (Newport News Waterworks) developed a water conservation program approximately 15 years ago and was modified in 2005 (effective January, 2007). The pan is based on encouraging water conservation through surcharges and penalties for excess use, and restrictions during drought conditions. This plan...."
    Other Alternatives Considered: Delete the sentence "The plan is under revision, to be effective FY2006."
    Page 179, Rec Action Item #9: Should be the exact same changes as above for page 153.
    Response: Revised.

Comments and Responses to the Draft Natural Hazard Mitigation Plan, dated November 18, 2005
Draft #5

Reviewer: Hibak Hersi
Agency: Virginia Department of Emergency Management

1. **Planning Process Element D (Crosswalk p.5) –** We included several sentences in Section 3 (Steps 1 and 3) to indicate that project managers invited Hampton University, Thomas Nelson Community College, the College of William & Mary, the SE Community Redevelopment Office, and school systems. Businesses were invited to participate in the team planning process through an invite extended to the Peninsula Chamber of Commerce. Non-profits were addressed through the public comment periods and notifications in local newspapers. We indicated that the letters and emails of invitation to these groups are not included in the plan, but maintained by Newport News Emergency Management.
2. **Profiling Hazards, Element B (Crosswalk p. 6) –** As you and I discussed, the surge maps are intended to be a part of the plan and we will be sure to include all community surge maps in the new submittal. We have included a complete subsection regarding storm surge and storm surge mapping in Section 4.1.3. We kept the surge discussion as a subsection of Hurricanes and Tropical Storms because the surge is a secondary hazard caused by the tropical systems; it can't occur on its own. We feel that the local erosion hazard is, likewise, a secondary hazard related to storms and sea level rise, so we added language to this effect in Section 4.1.1, Multi-Hazard Correlation. We provided a further description of erosion under nor'easters, and then include community-specific references for York Co b/c erosion is addressed in their Comprehensive Plan (see Section 5.5.4). The communities were asked to provide whatever additional info they could on winter storms and nor'easters on several occasions. They do not maintain collected records and have next to no data on damages or costs. Upon further inquiry, AMEC received some limited information from York County. They provided some general cost estimates on recent storms which were included in the text, however, the few sentences on separate hazards did not justify entire community sections devoted to these hazards so the data was included in the historical descriptions of events for the entire planning region in Table 5.5.1b.
3. **Assessing Vulnerability: Identifying Structures (Crosswalk p. 7) –** No change to the plan. We will recommend that the communities consider including future development plans in the plan when they do a 5-year update.
4. **Multi-Jurisdictional Risk Assessment (Crosswalk p.9) –** We understand the inclusion of "Thunderstorms" was a mistake, and that "Nor'easters" was intended. Under Risk Assessment, VDEM has asked that we address Nor'easters, winter storms, storm surge, and erosion more thoroughly for each jurisdiction. Again, erosion and storm surge are secondary hazards as they are a result of storms and/or sea level rise. The discussion of erosion and storm surge is addressed for each *storm* through the Hurricane discussions and the very detailed descriptions of individual historical hurricanes and their effects on regional jurisdictions. Please note that Appendix C, Catalog of Virginia's Historical Hurricanes, provides detailed accounts of the effects of storm surge and erosion resulting from hurricanes since the mid-1500s. As FEMA requires that the risk assessment assess each jurisdiction's risk "*where they vary from the risks facing the entire planning area*", we are puzzled at how to differentiate between the jurisdictions with regard to winter storms and Nor'easters. All of the Peninsula is subject to these storms, and all jurisdictions have suffered their effects on many occasions over their history. The effects are often hard to quantify as they are primarily incurred by individual homeowners as a result of power outages, and by local governments from clearing/prepping roads. We attempted to contact Virginia Dominion Power and the Media Relations department thereof to determine the extent, duration, and costs of power outages as a result, and we again asked the communities to provide any data of costs from these storms. We did not receive any response from any of them. Additional data added to 4.1.16 on tsunamis, as available.
5. **Implementation of Mitigation Actions (Crosswalk p.11) –** We will modify wording of several Recommended Actions to include "continued compliance with the NFIP", as this is the overall intent of the recommended actions. We will also provide a sentence that all communities are planning to have continued compliance with the NFIP.

References

Boesch, Donald and Jack Greer, et al. *Chesapeake Futures; Choices for the 21st Century Chesapeake Bay Program*, undated, available for viewing at http://www.chesapeake.org/stac/futreport.html

Boston Globe, 2004, N.E. is not immune, scientists warn. December 28, 2004.

Conrad, D., McNitt, B., and Stout, M., 1998. *Higher Ground: A Report on Voluntary Property Buyouts in the Nation's Floodplains, A Common Ground Solution Serving People at Risk, Taxpayers and the Environment*. National Wildlife Federation, Washington, D.C., July 1998.

Driscoll, N.W., Weissel, J.K., and Goff, J.A., 2000, *Potential for large-scale submarine slope failure and tsunami generation along the US mid-Atlantic Coast (pdf). Geology:* May 2000, v. 28, no. 5, p. 407-410.

Fujita 1971. Fujita Damage Scale. (Online). Available at http://www.ncdc.noaa.gov/oa/satellite/satelliteseye/educational/fujita.html

Maine Geological Survey (Online), *Tsunamis in the Atlantic Ocean*, at http://www.maine.gov/doc/nrimc/mgs/explore/hazards/tsunami/jan05.htm. October 2005.

NOAA 1999. National Oceanic and Atmospheric Administration, National Weather Service. Climate of 1999 – June – August; Drought in the U.S., 15 September 1999. (Online). Available at http://www.ncdc.noaa.gov/oa/climate/research/1999/sum/us_drought.html#heat. 8 December 2004

NOAA Technical Report NOS CO-OPS 36, *Sea Level Variations of the United States 1854-1999*, July 2001.

NOAA 2004. National Oceanic and Atmospheric Administration, National Weather Service. (Online). Available at http://www.crh.noaa.gov/pub/heat.htm. 8 December 2004.

NWUIFPP undated. Wildland/Urban Interface Fire Hazard Methodology. National Wildland Urban Interface Fire Protection Program, undated. (Online) Available at http://www.fema.gov/pdf/reg-viii/wham.pdf

Office of Technology Assessment, United States Congress, *Preparing for an Uncertain Climate*, 1993.

Sammler, William. Personal interview, September 15, 2005. (National Weather Service, Warning Coordination Meteorologist, Wakefield, Virginia office.)

United States Geological Survey (Online) *Earthquake History of Virginia, a*vailable at http://neic.usgs.gov/neis/states/virginia/virginia_history.html, 2004.

Virginia Department of Emergency Management. (Online) *Virginia Winters; Snow, Wind, Ice, and Cold.* Available at: http://www.vdem.state.va.us/library/vawinter/va-win.htm 2004.

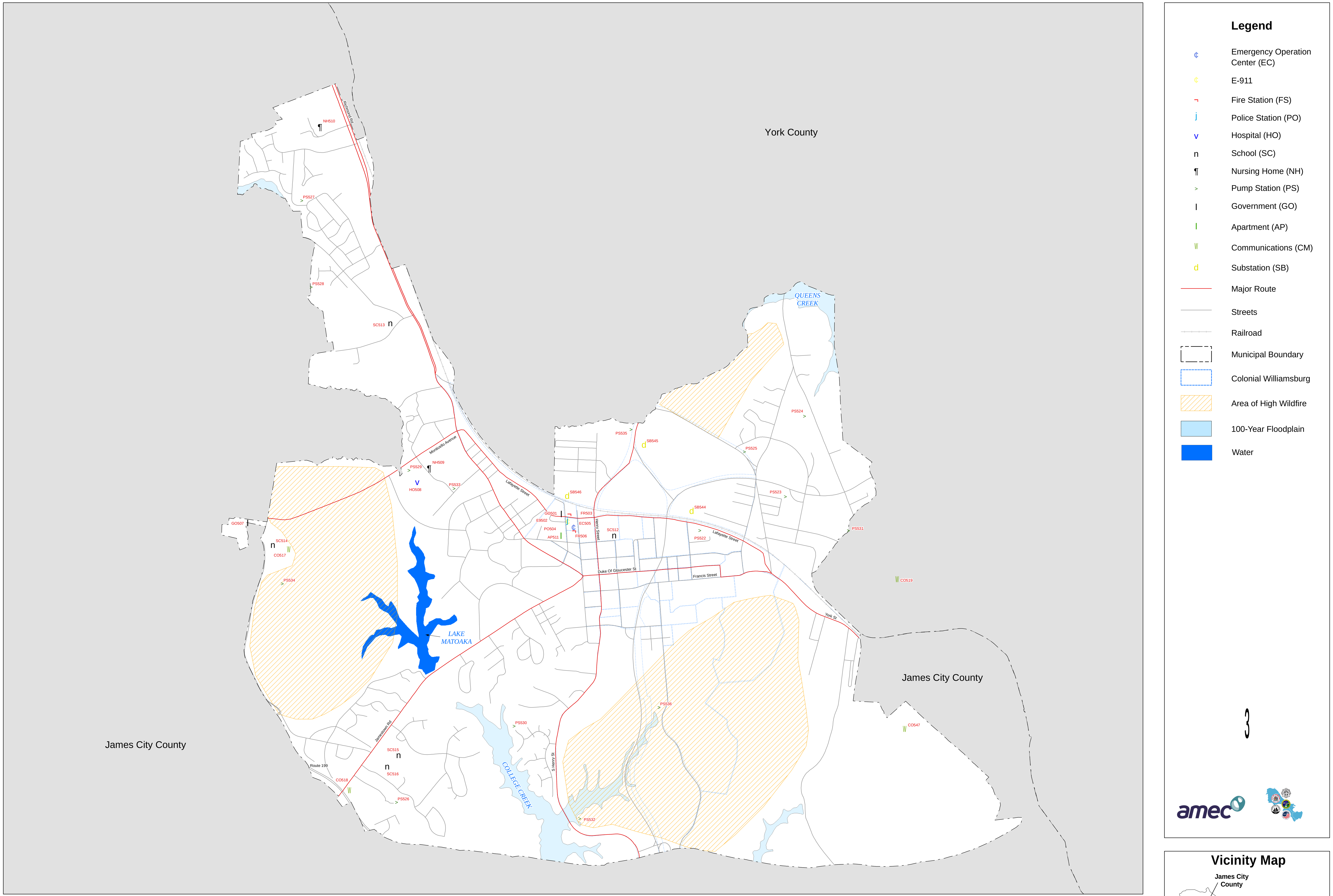
Virginia Drought Monitoring Task Force, *Drought Status Report*, August 19, 2002 and November 25, 2002.

Virginia Employment Commission, Electronic Labor Market Analysis. (Online). Available at: http://velma.virtuallmi.com/analyzer/startanalyzer.asp. 2005

Virginia Soil and Water Conversation Board. (Online) Available at http://www.dcr.virginia.gov/sw/damsafty.htm

Virginia Tech Seismological Observatory. (Online) Available at http://www.geol.vt.edu/outreach/vtso/ and http://www.geol.vt.edu/outreach/vtso/Giles-Intensity.htm.

Weldon Cooper Center for Public Service, *Population Estimates for Virginia Cities & Counties, 2001-2004* (Online) Available at: www.coopercenter.org/demographics, January 2005.



General Disclaimer

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Data Sources:

Flooding - Flooding was digitized from the existing FEMA Flood Insurance mapping for the City of Williamsburg by AMEC
Wildfire - Virginia Department of Forestry, corrected by City staff
Critical Facilites - Identified and located by City staff
Land use Boundaries - Identified and located by City staff
Roads and Rail - Provided by James City County GIS
City Boundary - U.S. Census TIGER files

1:12,000

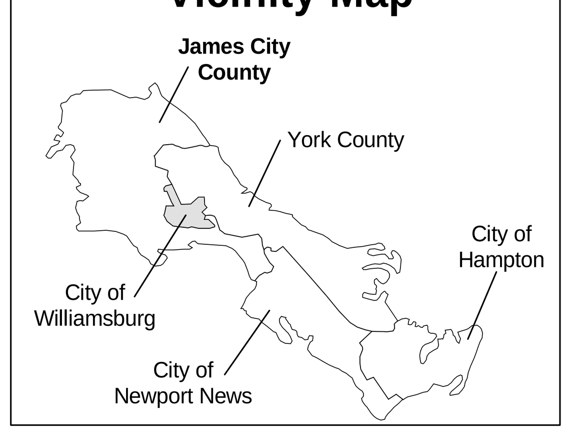
0 1,450 2,900 5,800 Feet

Peninsula Multi-Jurisdictional Natural Hazards Mitigation Plan

September 2005

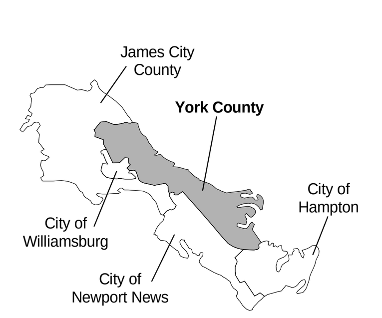
City of Williamsburg, Virginia Multi-Hazards Map

Vicinity Map



Legend

¬	Fire Station (FS)
n	School (SC)
>	Pump Stations (PS)
I	Local Government (LG)
c	Library (LB)
(	Critical Facilities at Risk, Category 3 Hurricane Surge Zone
	Major Route
	Street
	County Boundary
	Area of High Wildfire Risk
	100-Year Floodplain (Zones A & AE)
	100-Year Floodplain (V Zone)
	Water



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Data Sources:
The Virginia Department of Forestry provided the wildfire risk layer.
The York County GIS Department provided the following data layers:
Emergency Operations Centers
Fire Departments
Hospitals and Clinics
Schools and Colleges
Retirement Communities
Hazardous Materials
Flood Zones
Streets and Railroads

1:24,000

0 2,400 4,800 9,600 Feet

Peninsula Multi-Jurisdictional Natural Hazards Mitigation Plan

September 2005

York County, Virginia Multi-Hazards Map